Navigating the Arctic's 7Cs

Edited By: Mike Sfraga and Jack Durkee

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Cover image: Map of Arctic by NOAA climate.gov based on bathymetry data from NASA's Blue Marble. large maps: Arctic.

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Ambassador Mark Green, Director, President, & CEO

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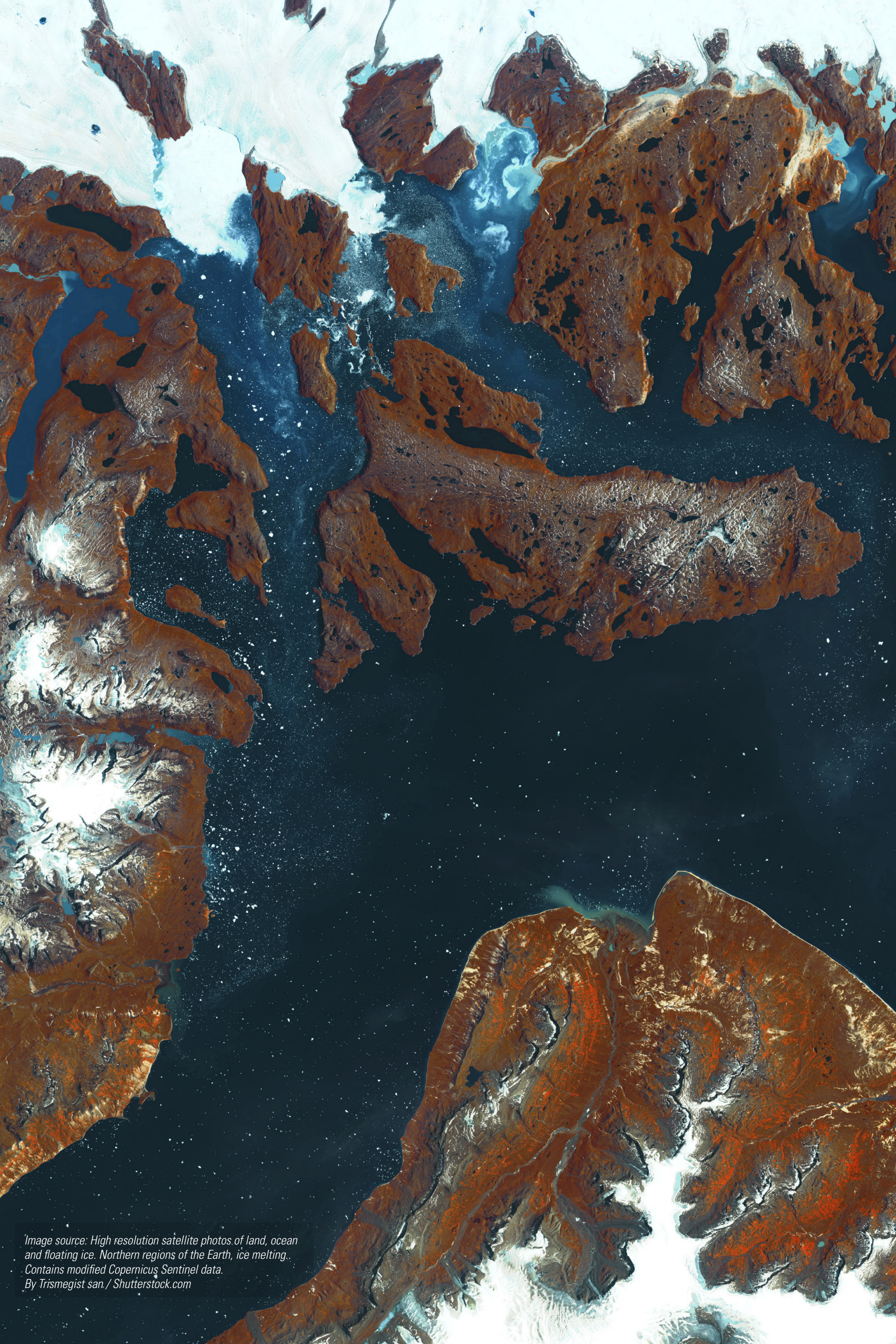

Image source: High resolution satellite photos of land, ocean and floating ice. Northern regions of the Earth, ice melting.. Contains modified Copernicus Sentinel data.
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PREFACE

By Ambassador Mark Green, Director, President, & CEO, Wilson Center

Image source: Aurora borealis above snowy islands of Lofoten. By Weston / Shutterstock.com

The world is just beginning to recognize the importance of the Arctic. Its environment drives global weather patterns, but also serves as a bellwether for the changes our planet is undergoing as a result of a rapidly changing global climate; it has vibrant Indigenous communities that celebrate their traditional ties to the land and play an increasingly crucial role in regional and international governance; it has vast economic potential in natural resource development, the blue ocean economy, alternative energy sources and technologies; and the cooperative nature amongst Arctic states in addressing the foregoing issues and opportunities can serve as a model for constructive international governance in other regions.

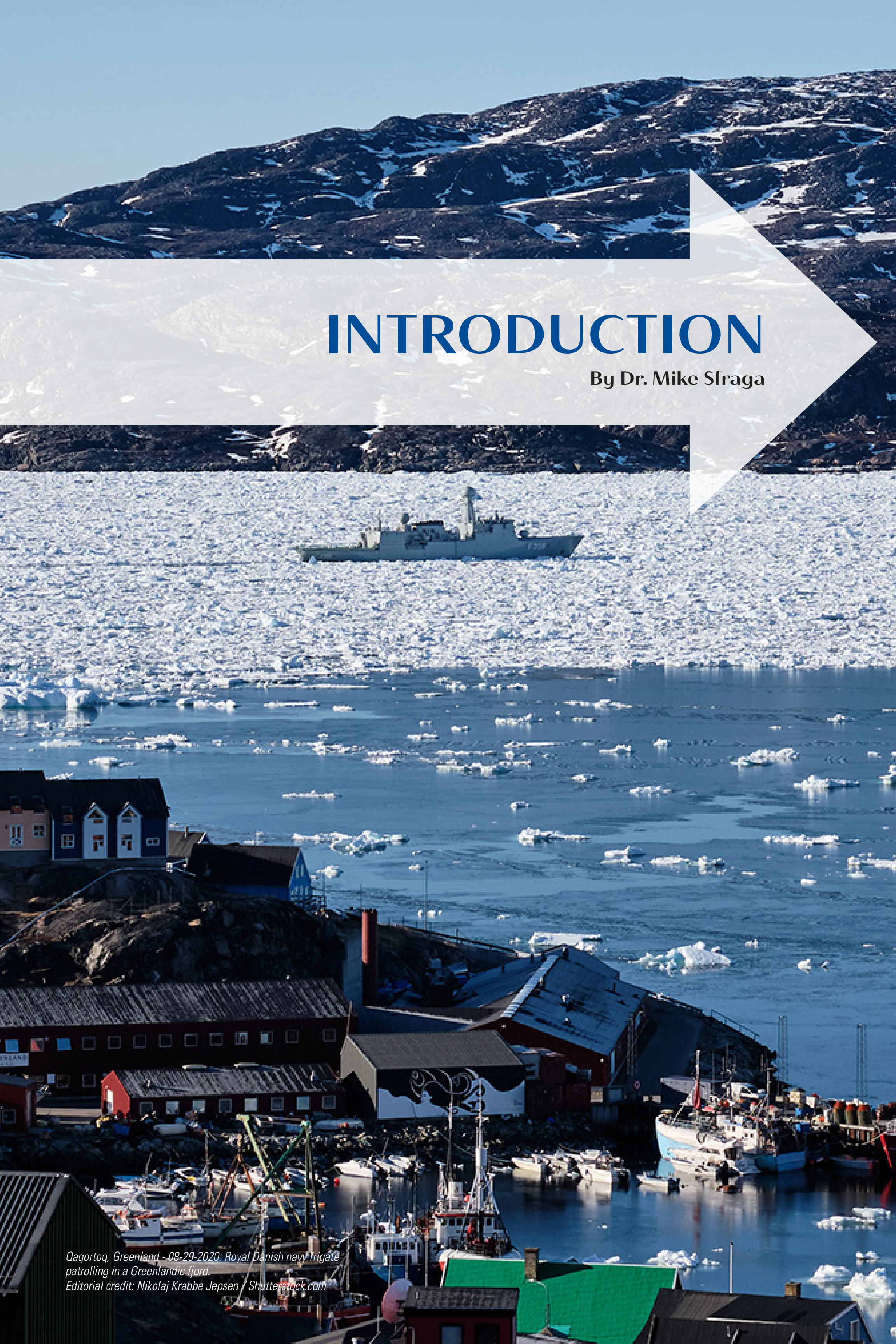
In short, while it is hard to overstate the complexities of many of the issues facing the Arctic region, it is also hard to overstate the importance to all involved for those issues to be addressed in an equitable, sustainable manner. The foreign policy community in the United States and around the world must learn how to better live, work, operate, and interact in the Arctic. Those who live in the Arctic and experts who study the region should help clarify and contextualize the range of policy choices at hand. All of us need to better communicate to stakeholders and the broader public why the Arctic matters, not just right now, but for years to come.

Navigating the Arctic's 7Cs will advance our conceptual understanding of the Arctic and, I am confident, lead to more effective solutions to the challenges evident there. This framework breaks down the nuances of specific issues, and puts forward a frame-of-mind within which to consider the Arctic. Simplifying these issues, perhaps paradoxically, reveals just how interrelated each is to the other: how environmental changes impact all the other issues present in the region; how proper economic development needs Indigenous leadership…the list goes on and on. *Navigating the Arctic's 7Cs* is a guide to the Arctic, a roadmap to better understanding and a more informed approach for stakeholders looking northward.

This framework is the Wilson Center at its best: we convene experts to illuminate the factors that drive forward foreign policy. It's a role we have embraced for over 50 years, and with frameworks like *Navigating the Arctic's 7Cs,* we can continue to provide leading analysis for more deliberate US foreign policy.

INTRODUCTION

By Dr. Mike Sfraga



Qaqortoq, Greenland - 08-29-2020: Royal Danish navy frigate patrolling in a Greenlandic fjord.
Editorial credit: Nikolaj Krabbe Jepsen / Shutterstock.com

The Origins of a Conceptual Framework

For years, members of Congress and other government leaders have conveyed to me their awareness of the Arctic region's growing importance to the nation; they also conveyed a need to better understand, synthesize, and crystalize the many issues that were quickly unfolding throughout the region. Members of the United States Congress—indeed all policymakers in the United States and elsewhere—have many issues to address. Their comments were not stinging rebukes of the importance of the Arctic nor a failing grade in communicating why the Arctic matters. Rather, I took these exchanges as a challenge that needed a response.

It seems incumbent upon the Arctic policy community to identify the most pressing issues to address in the region while simultaneously, effectively and creatively communicating their complexities and interrelated nature. What members of Congress and others needed, I thought, was a conceptual framework that would help explain and address the nation's Arctic interests and objectives.

The Arctic has evolved from the perception of a cold, dark, remote, isolated, and disconnected region—used brilliantly over 200 years ago by Mary Shelley as the backdrop for her famous novel *Frankenstein*—to a new, interconnected, increasingly consequential, and globalized Arctic. But why has the Arctic become the topic of an ever-increasing number of news stories, documentaries, and Congressional hearings? How can we better frame the issues for U.S. lawmakers in a way that advances a whole-of-government approach to the region?

Reflecting on these questions, I considered seven key issues and drivers at play in today's Arctic, and to my surprise, each of them began with the letter C.

The Cs fell in place easily as I reflected on the issues my colleagues and I address at the Wilson Center's Polar Institute: **climate**, **commodities**,

commerce, **connectivity**, **communities**, **cooperation**, **and competition**. It became clear that how effectively the United States, and indeed all Arctic and non-Arctic nations, navigate these Cs would determine the future of the Arctic. Individually they capture key areas for further policy discussion and implementation. In aggregate, they create an integrated group of seven "buckets" that can inform and influence policymakers in the United States and abroad.

I realized the framework could also be a foundation to communicate the importance of the Arctic region to the general public—a critical component of public policy work. To be effective, frameworks require utility, details, and context. The framework I was developing also needed to be memorable because the issues of the Arctic are competing for attention with all the other pressing global issues and hotspots. As such, the framework needed an "elevator pitch." As most individuals are familiar with some variation of the term "navigating the seven seas" in a nautical context, it seemed fitting to apply the term to this new framework. Hence, "*Navigating the Arctic's 7 Cs*" was created.

Yet a framework without substance is of no value. Over the better part of three years, I refined presentations and keynote speeches using the 7Cs framework. At times, these presentations provided a broad perspective of the Arctic, while others dug deep into one or more of the key components of the framework. Still other programs and presentations used the concept as a foundation upon which other Arctic-related themes were explored. The utility of the framework for me and, more importantly, for other scholars and policy experts became clear.

As a natural progression from this effort, and at the urging of colleagues at the Wilson Center and elsewhere, I began work on this monograph. The following seven chapters reflect the expertise, insights, and perspectives of nine colleagues utilizing the 7Cs framework in a manner of their choosing. Some authors decided to explore the Arctic in a global context. Others present local, regional, U.S. domestic, or circumpolar ideas, insights, and concepts.

This is the way the framework was designed: to capture, in broad terms, the pressing issues evident in the Arctic and enable public policy experts and others to explore themes from the micro to the macro level. The 7Cs provide to policymakers a more clear and applicable connection between their daily duties and responsibilities to the broader challenges and opportunities evident in the Arctic. For those living and working in the Arctic, we understand it is a big neighborhood yet a small community. For those who do not live in the Arctic but are duty-bound to make decisions about the region's future, relevant, applicable, meaningful, and easily communicated insights and recommendations are required.

Navigating the Arctic's 7 Cs

Climate change is the key driver reshaping the physical and geopolitical landscape of the Arctic. As we now know, the Arctic is warming three times the global average, Arctic sea ice extent and thickness continues to decrease drastically, the consequence of thawing permafrost impacts Indigenous communities and threatens critical infrastructure, and fires in the Arctic are more frequent and intense. Any framework that explores the key drivers of change in the Arctic must start with climate change; it is real, rapid, and relentless. **Dr. Brendan Kelly and Ms. Elizabeth Francis** take us on a climate tour de force, exploring the composition of and changes to our global climate system, the human impacts on this system, and as a result, the very real and accelerated changes occurring today throughout the Arctic.

As Arctic sea ice continues to diminish at an alarming rate, the opportunities that may arise for communities and nations interested in developing once inaccessible natural resources has drawn more attention. Access to the Arctic Ocean will continue to increase in the coming decades, and so will access to the Arctic's vast reserves of oil and gas. A host of other **commodities** will become more accessible, from fish stocks and broader aquaculture opportunities, to integrated blue ocean economies, to rare earth and strategic minerals, to forest products. As **Dr. Mark Myers** explores this vast portfolio of resources, he emphasizes the important role technology and innovation will play in enabling sustainable economic development throughout the region, as well as identifying, developing, and managing Arctic **commodities** essential to a growing global population.

In a chapter for the spring 2021 edition of *Proceedings*, the Journal of the United States Coast Guard's Marine Safety and Security Council, I noted, "Increased access to a wide array of natural resource commodities has led directly to an increase in shipping and related activities in the Arctic, most notably in the Russian Arctic."[1] Building on the implications of a more

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1 Mike Sfraga. Spring, 2021. Navigating the Arctic's 7 Cs: U.S. Coast Guard advancing America's interests in the Arctic. Proceedings: The Coast Guard Journal of Safety and Security at Sea, Marine Safety and Security Council, 6-11 (spring, 2021).

accessible and navigable Arctic Ocean, **Dr. Lawson Brigham** provides important insight and context to the varying narratives about the realities of current and future Arctic shipping routes. There is no doubt Arctic commerce and related activities have increased in recent years, but the region remains infrastructure poor, requires capital from outside of the region to grow, and must develop clear and ensured governance structures that regulate and monitor marine transportation and related activities. Consequently, shipping in the Arctic should be considered in the broader context of other, more expansive international shipping regimes and capacities.

I have argued **connectivity** in the Arctic must be reconsidered and reconceptualized beyond the more traditional definition focused on internet **connectivity**. The tyranny of distance reigns supreme in the Arctic and the only way to better serve communities and build a sustainable workforce or health care system, enable and enhance economic development, support national and homeland security interests, and improve our understanding of the physical environment, is to broaden our definition of what **connectivity** in the Arctic should look like. **Dr. Alyson Azzara** provides her own take on this argument, teasing out the interconnectedness that already exists in the region: a connected landscape, an integrated ocean system, a shared need for infrastructure from ports to roads to rail, social and cultural ties that bind, and equitable access to basic community services. **Dr. Azzara** takes us from the practical, technical **connectivity** challenges in the Arctic to those that are social and political in nature; all of which, in the end, require a broader definition and shared action.

Each region of the Arctic is different. Each **community** in the Arctic is different. The Arctic is not monolithic; no one **community**, region, sub-national region, or nation-state can speak for another. Yet they all have shared experiences. So, when it came time to explore the issue of **communities** within the 7Cs framework, I reached out to Dr. **Gwen Healey Akearok**, a Fulbright Scholar raised in and living in Iqaluit, Baffin Island, Canada. I asked **Dr. Healy Akearok** to write a chapter that is personal, that is "of" her community, one that would take the reader on a journey of insight through the lens of a community member who deals daily with the triumphs and challenges of living in the Arctic. **Dr. Healy Akearok's** intimate narrative proposes a comprehensive exploration of health and well-being in the circumpolar Arctic. By privileging the voices of community members, her community-engaged, strengths-based analysis results in recommendations to reduce inequities, support Indigenous expertise and existing knowledge, and promote thriving communities in the Arctic.

Although great power narratives that include the United States, Russia, and China often capture the headlines, **cooperation** among Arctic and non-Arctic states is considerable, essential, and perhaps lost in such predominant narratives. Nevertheless, it is important to note that **cooperation** in the Artic is productive, inclusive, and growing. As **Ambassador David Balton** points out, changes to the physical and political environment have created both challenges and opportunities since the end of Cold War. During this period, Balton notes, there has been an increase in the number of "international institutions and arrangements intended to manage expanding human activity in the Arctic and deepen human understanding of the region." Indeed, **Balton** provides much-needed contextual balance, insight, and foresight into the impressive number of sustained, cooperative, and coordinated efforts occurring throughout the Arctic. Such efforts include those of the Arctic Council, International Maritime Organization, Central Arctic Oceans Fisheries Agreement, Arctic Economic Council, and the Arctic Science Ministerial meetings. **Balton** also offers suggestions to enhance and strengthen existing organizations and entities to adapt to new demands and requirements brought about by a new Arctic region.

Great power competition in the Arctic is real. Yet, as **Dr. Stacy Closson** and **Mr. Jim Townsend** argue, states may more effectively manage the risk of an armed conflict in the Arctic—predominantly with Russia—through a series of actions that bring clarity to the threat of conflict, enhance deterrence capabilities, simultaneously establish modest levels of trust through confidence-building mechanisms, and enhance existing alliances. Of concern to most Arctic nations is the increased number and sophistication of new and refurbished Russian and Soviet-era military bases, coupled with a more robust tempo and varying designs of training schemes, as well as publicly stated military and security aspirations. As a result, the United States has enhanced its Arctic presence and capabilities in Alaska, increased its training, domain awareness, and military exercises with NATO allies and partners in the GI-UK Gap (Greenland, Iceland, United Kingdom Gap) and throughout the European Arctic. The concern over **competition** in the Arctic is not limited to an armed conflict between the United States, Russia, and NATO: China has been more active in the Arctic in recent years. China has significant investments in Russian gas assets and related entities, actively seeks to broaden its economic influence in the region, increased its number of icebreakers and their activities in the Arctic Ocean, and enhanced its research capabilities that may have application beyond basic science. As we witness the opening of a new ocean, the Arctic Ocean, we must consider the security and competitive aspects of these realities and work to ensure these dimensions of a more globalized, accessible, and consequential Arctic are managed well to ensure the possibility of an armed conflict in the region remains low.

ACKNOWLEDGMENTS

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As is often the case when building a framework such as presented here, a small cadre of colleagues to brainstorm with is not only helpful but essential. Polar Institute colleagues Mr. Jack Durkee, Ms. Marisol Maddox, and Ms. Bethany Johnson joined me early in the process for a prolonged whiteboard session to tease out the *7Cs* framework; they informed and influenced my thinking and added significantly to the effort. This group of colleagues continuously helped to refine the framework as additional requests to present the *7Cs* in various iterations increased. Ms. Michaela Stith's recent addition to the Polar Institute team has brought additional support and expertise to the effort.

Indeed, Mr. Jack Durkee and Ms. Michaela Stith have been essential in making this monograph a reality. Their unabated encouragement and willingness to take on additional responsibilities to enable this monograph to take shape is appreciated.

Many more colleagues at the Wilson Center were central to making this monograph possible. I thank them for generously providing guidance and support in the midst of carrying out their own essential duties guiding the Center through the realities of a global pandemic. In this regard I thank Ms. Linda Roth, Mr. Eddy Acevedo, Ms. Elyse Drum, Ms. Natasha Jacome, Ms. Kathy Butterfield, Ms. Kerrin Cuison, Ms. Lauren Booth, and Ms. Sue Howard.

Ms. Sandra Yin's editorial expertise and purposeful approach in reviewing this manuscript is not only appreciated but made the final product far better. Ms. Olivia Wynne Houck and Mr. Jackson Blackwell worked diligently in the editing process and I thank them both for doing so.

And finally, a heartfelt thank you to my nine colleagues, the principle authors of this work, for graciously taking time away from other demands to provide invaluable insight and analysis on the future of the Arctic region: Dr. Brendan Kelly, Ms. Elizabeth Francis, Dr. Mark Myers, Dr. Lawson Brigham, Dr. Alyson Azzara, Dr. Gwen Healey Akearok, Ambassador David Balton, Dr. Stacy Closson, and Mr. Jim Townsend. The expert insight they offer in the following chapters will provide a more informed and purposeful approach for *Navigating the Arctic's 7Cs*.

Melting glaciers in the northern ocean: *Source*: By luchschenF / Shutterstock.com

ABOUT THE AUTHOR

Dr. Mike Sfraga is the founding director of the Polar Institute and also serves as the director of the Global Risk and Resilience Program at the Woodrow Wilson International Center for Scholars. President Biden recently appointed Dr. Sfraga incoming Chairman of the United States Arctic Research Commission. An Alaskan and a geographer by training, his work focuses on the changing geography of the Arctic and Antarctic landscapes, Arctic policy, and the impacts and implications of a changing climate on political, social, economic, environmental, and security regimes in the Arctic.

Sfraga served as distinguished co-lead scholar for the U.S. Department of State's inaugural Fulbright Arctic Initiative from 2015-2017, a complementary program to the U.S. Chairmanship of the Arctic Council; he held the same position from 2017-2019. He served as chair of the 2020 Committee of Visitors Review of the Section for Arctic Science (ARC), Office of Polar Programs, National Science Foundation, and currently serves on the Finnish Institute for International Affairs Scientific Advisory Council (SAC). Sfraga previously served in a number of academic, administrative, and executive positions including vice chancellor, associate vice president, faculty member, department chair, and associate dean.

Sfraga has testified before the U.S. Senate and House of Representatives, he maintains an active national and international speaking and facilitation schedule, and his commentary has been featured in several major media outlets including MSNBC, National Public Radio, Voice of America, The Wall Street Journal, Alaska Public Media, CCTV/CGTN, Bloomberg News, and C-SPAN.

Sfraga is the author of the biography *Bradford Washburn: A Life of Exploration*, is affiliate professor at the International Arctic Research Center, University of Alaska Fairbanks, serves as the co-director of the University of the Arctic's Institute for Arctic Policy, and has served on a number of non-profit boards and advisory committees.

Glacier Bay, Johns Hopkins Glacier in Alaska, USA. *Source*: By Maridav / Shutterstock.com

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By Dr. Brendan P. Kelly and Ms. Elizabeth Francis

Navigating the Impacts of Climate Change in the Arctic

EXECUTIVE SUMMARY

Changes in Arctic environments are accelerating the warming of the entire planet at rates not experienced since modern humans evolved. In the past 250 years, excessive carbon—primarily from burning fossil fuels—has accumulated in the atmosphere, rapidly increasing global temperatures. In recent decades, changes in the Arctic amplified the temperature increases and were equivalent to 25 percent of the global warming from carbon dioxide accumulated in the atmosphere. The rapid warming is outpacing species' and societies' abilities to adapt.

The amount of carbon dioxide and methane in the atmosphere has varied substantially over the past 500 million years driving changes in Arctic and global climates. Gradual climate changes favored adaptive evolution and the proliferation of new species, while abrupt changes precipitated five mass extinctions. The recent warming of the planet—driven by fossil fuel emissions and amplified by diminishing ice in the Arctic—has been especially abrupt. This latest warming is driving the sixth mass extinction.

Diminished sea ice, ocean acidification, and sea level rise will increasingly affect the Arctic marine ecosystem, geopolitical stability, and many subsistence and commercial activities. The Arctic will continue to warm in the coming century, and the difference between socially and ecologically ruinous consequences will depend primarily on the degree to which we lower carbon emissions. To avoid the worst impacts, we will need to reduce atmospheric carbon concentrations below present levels.

INTRODUCTION

August Kekulé credited a dream in 1862 with helping him solve an important mystery in carbon chemistry—the structure of benzene.[1] He dreamt that molecules comprising a chain of carbon atoms were moving like a snake in front of him. When the snake took its tail in its mouth, Kekulé woke up and realized that benzene was not, as had been assumed, carbon atoms arranged in a line but rather, in a ring. The insight opened the study of cyclic carbon compounds—an important aspect of petroleum chemistry and biology. We start with Kekulé's dream, because carbon is central to the heat balance of the planet and hence, to climates. Indeed, we could have added "carbon" to our list of "Cs" and chapters, because its accumulation in the form of carbon dioxide and methane in our atmosphere is the major contributor to rapid warming of the Arctic.[2]

A region's climate comprises averages of temperature, humidity, atmospheric pressure, and precipitation. Combinations of those features give rise to distinctive climates which, in turn, provide the contexts in which ecosystems and societies evolve.[3] For example, a coastal climate produces ecological communities and human communities that are distinctly different than those produced by a continental climate. Where human communities exist greatly depends on the climate. But for nearly all of the 200,000 years since modern humans emerged, the commerce, cooperation, and competition of those communities had little discernable effect on climate.[4] But the relationship between human activities and climate began to change about 250 years ago when coal became a commodity and a driver of climate.[5] As we have burned more fossil fuels, we have altered climates across the globe with the most pronounced changes taking place in the Arctic.[6]

While climates are described as conditions averaged over decades, they also encompass seasonal variations. Moreover, climates can change over time. Indeed, there have been large changes in the earth's climate over millennia (Figure 1) including surface temperatures of 80 °F in the Arctic Ocean 53-54 million years ago when alligators inhabited swamp forests on Ellesmere Island.[7]

What drives climates to change over seasons and longer periods? At the global scale, the major drivers are the amount of heat from the sun that the planet absorbs and the amount leaving the planet as reflected solar energy and radiated heat. That amount varies with earth's movements relative to the sun and with feedbacks involving atmospheric greenhouse gases and clouds, ocean and atmospheric circulations, the reflectivity of different surfaces on the planet, and the amount of carbon locked up in plants.[8]

Carbon dioxide and methane each comprise considerably less than 1 percent of the atmosphere, and their concentrations have varied widely with impacts on the earth's temperature that belie their low concentrations. The molecular structure of carbon dioxide and methane is such that solar energy passes through to warm the earth's surface, but they absorb and re-radiate heat energy, some of which is radiated back toward the surface of the planet. Thus, the more carbon dioxide and methane in the atmosphere, the more heat builds up in the earth's atmosphere, land, and oceans.

The regular changes in the earth's distance from and angle to the sun (the Milankovitch cycles) are well known and accounted for in climate models as are the consequences of varying amounts of greenhouse gases (carbon dioxide, methane, water vapor, ozone, nitrous oxide, and chlorofluorocarbons) in the atmosphere.[9] Less well understood are the climate impacts of myriad feedbacks—such as the complex role of clouds—but climate scientists are making tremendous progress in learning how those feedbacks, singly and in combination, influence climates.[10]

Arctic Climate Before Humans

Since Earth formed some 4.5 billion years ago, its climate has varied tremendously in response to the rhythms of its relationship to the sun and to the evolving composition of its surrounding gases (atmosphere), oceans and other waters (hydrosphere), land (lithosphere), and life (biosphere). Long before humans changed the composition of the atmosphere—and with it the climate—

the evolution of plants dramatically altered the ratios of gases—especially oxygen and carbon dioxide—in the atmosphere, eventually establishing conditions conducive to animal life.[11] Oxygen, generated by plant photosynthesis, began increasing in the atmosphere with the rise of land plants about 440 million years ago and stabilized near current levels (21 percent of the atmosphere) about 400 million years ago.[12] That high and stable concentration of oxygen was necessary for the evolution of large animals, including, eventually, people. Complex interactions including burial of plant matter and fires maintained equilibrium levels of oxygen in the atmosphere.

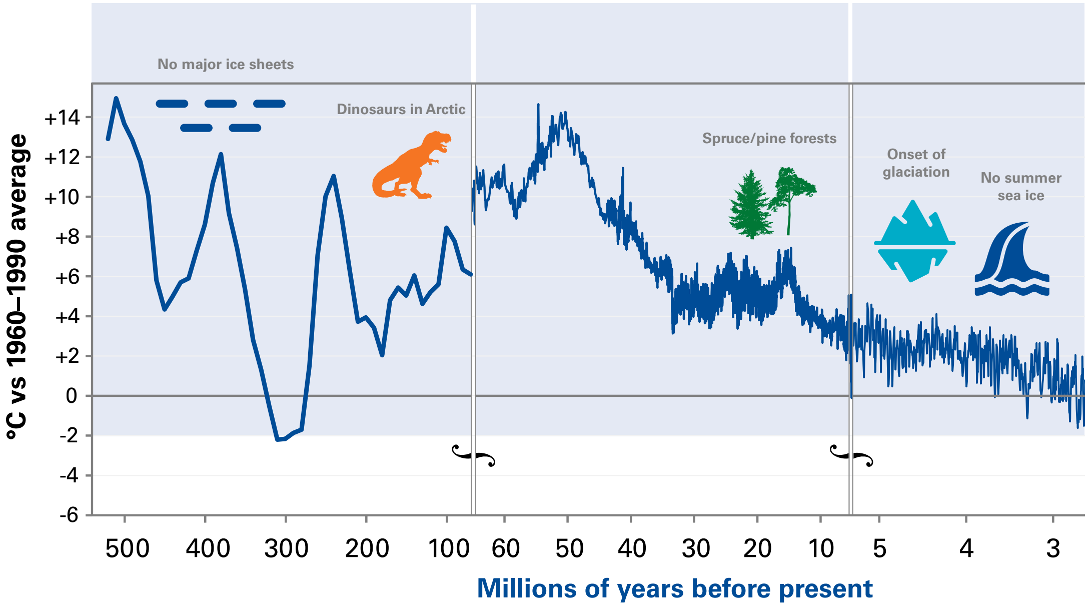
At the same time, the lithosphere continued to evolve as continents formed and reformed. The most recent separation of land masses into distinct continents, which began about 200 million years ago, influenced ocean and atmospheric circulation patterns and thereby, the distribution of heat throughout the globe contributing to the rise of distinct regional climates, including that of the Arctic.[13]

Reconstruction of past climates is a sophisticated science that takes advantage of chemical markers preserved in ice and rocks to inform us about past temperatures; levels of humidity; the presence or absence of ice, water, fire; and more. Together, those proxies reveal details about past climates, even if the records become more faint the further back we look. Given that modern humans have been on the planet for less than 0.005 percent of Earth's history, we could concern ourselves only with climate in the subsequent period, but climates that predate our species greatly inform understanding of how climate drivers interact. Therefore, they are quite useful in predicting how climates will change in the future. The evolution of the Arctic climate over the past 550 million years, the interval in which most life evolved, puts the current and future Arctic in context (Figure 1).

Fluctuations—some quite large—in the amount of carbon dioxide and methane in the atmosphere have repeatedly driven climate change with substantial consequences for plants, animals, and ecosystems. When conspicuous life first evolved 550 million years ago, Earth was as much as 25 °F warmer than in recent decades.[14] Just after 400 million years ago, atmospheric carbon dioxide declined dramatically—apparently as large amounts of plant matter were buried—leading to dramatic cooling and glaciation.[15] The cold period gave way to abrupt warming 250–300 million years ago apparently due to increased carbon dioxide in the atmosphere as the result of volcanic eruptions and sudden releases of methane by large blooms of methane-producing bacteria.[16] Whatever its cause, the abrupt warming in that period led to The Great Dying Event when 90 percent of the planet's species went extinct. The extinctions likely resulted from insufficient nutrients in the extremely warm ocean.[17] Nutrient levels recovered only 6–7 million years later.

Yet another mass extinction took place about 55 million years ago when massive releases of carbon dioxide caused the average global temperature to rise to 73ºF (today's average temperature is just below 60ºF). Possible sources for that release of carbon dioxide include drying inland seas, volcanic eruptions, thawing permafrost, methane release from the sea floor, and wildfires.[18] The Arctic of 50–60 million years ago was hot, its ocean covered in floating ferns, with the land supporting palm trees, alligators, and turtles.[19] Subsequent cooling introduced sea ice in the Arctic by 47 million years ago, and by 15 million years ago, the Arctic, which was cooler but still much warmer than today, supported pine and spruce forests.[21] A long-term cooling trend continued leading to the onset of glaciation about 5 million years ago and winter—but not summer—sea ice between 2 and 3 million years ago. About 1 million years ago, global temperatures were below those of today, and cycles of glaciation and retreat dominated most of the subsequent period.[22] Ecosystems gradually transformed with the changing climate. For example, about 400,000 years ago, grizzly bears gave rise to polar bears, which eventually became specialized to hunt seals that had evolved to exploit sea ice habitats.[23] Bears, seals, and other species adapted over thousands of years to the sea ice environment. Indeed, evolutionary adaptation inevitably occurs gradually as subsequent generations accumulate traits that fit the environment. Abrupt environmental changes, on the other hand, do not allow sufficient time for the accumulation of adaptive traits and often precipitate extinctions.

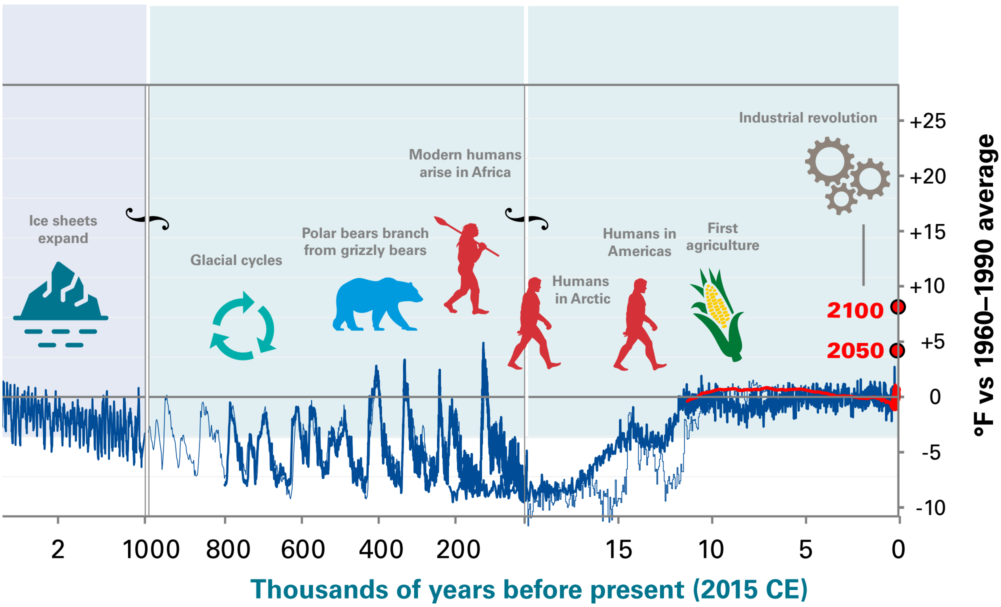
FIGURE 1: Reconstruction of Earth's Temperature



Note: This figure covers the last 550 million years showing key events in the Arctic and globally (modified after Fergus).[20] Global temperatures are shown as deviations above and below the average temperature between 1960 and 1990 (horizontal line). The present is on the extreme right. At each of the double vertical lines, the time scale changes. If the scale from 20,000 years ago to present were used throughout, the graphic would span 27,500 pages.

Human Colonization and Arctic Climate

Climate shifts have influenced human adaptation to the Arctic since mammoth hunters first appeared in the European Arctic some 45,000 years ago.[24] Humans crossed the Bering Land Bridge into Alaska 24,000–32,000 years ago but the surrounding ice sheets prevented them for several thousands of years from dispersing farther into the Americas.[25] Dispersal southward only began when the ice started retreating in the warming climate about 15,000 years ago.[26] The first in a series of movements into the North American Arctic came about 5,000 years ago when Paleo-Inuit relied on stone tools to harvest and process caribou,



musk ox, and seals.[27] During a cold period about 2,800 years ago, the population of Paleo-Inuit expanded in the eastern Canadian Arctic and Greenland as they increased hunting of marine mammals including walruses. For more than 4,000 years, the Paleo-Inuit moved repeatedly as the availability of ice-associated marine mammals shifted with climate fluctuations.[28] About 2,000 years ago, they abandoned Greenland and the High Arctic of Canada for close to 1,000 years before recolonizing those regions as temperatures warmed. Between 1,200 and 1,000 years ago, the late Dorset Paleo-Inuit expanded out of the Foxe Basin and Baffin Island region northward to Ellesmere Island and Northwest Greenland and westward to Victoria Island.[29] While that migration coincided with warming temperatures, it is not clear to what degree it was driven by declining sea ice (and related opportunities to harvest walrus) in the Foxe Basin and Baffin Island region or by increased terrestrial and marine productivity to the north and west.

The Paleo-Inuit disappeared—for unknown reasons—within a few hundred years of the 13th century appearance of Thule people, the ancestors of modern Inuit, in the eastern Arctic.[30] The eastward expansion of the Thule from Alaska was thought to have been in response to warming about 1,000 years ago that might have enhanced opportunities to harvest marine prey—especially bowhead whales—to the east. A recent reanalysis, however, suggests that the migration took place closer to 800 years ago and may have been driven more by changes in social conditions than by a climatic shift.[31] The social drivers of the migration have not been identified and might themselves have been connected to climate conditions in Alaska.

Between 1400 and 1900, Inuit abandoned some regions of the Central Arctic and expanded their range southward into Hudson Bay and Labrador.[32] The shift may have been precipitated by colder temperatures and more persistent sea ice that interfered with bowhead whale hunting and likely was further influenced by trade opportunities with Europeans in the south.[33]

Norse settlements, founded in Greenland just over 1,000 years ago, were also affected by climate changes. For the first 250 years of their existence, the settlements experienced consistent warm conditions that allowed them to employ modified Norwegian agricultural practices supplemented by marine mammal hunting.[34] Abrupt cooling began almost 800 years ago as a series of volcanic eruptions reduced solar heating of the planet and forced the Norse in Greenland to shift to a greater reliance on marine mammal hunting.[35] The shift in diet was not sufficient, however, and the Norse abandoned their Greenland settlements around 1250 CE.

Climate and European Exploration and Exploitation of the Arctic

European interest in the Arctic increased in the 1500s as explorers from various countries sought trade routes; whale oil; and exotic goods such as furs, walrus ivory, and narwhal tusks.[36] Many of those voyages suffered setbacks or disasters in encounters with sea ice and severe weather. Most famously, perhaps, after abandoning two ships that were caught in the ice in Victoria Strait, Canada, the crew of the Franklin expedition perished in 1848. Many expeditions involved in the search for survivors expanded European knowledge of the Arctic, but they also suffered from inadequate knowledge of the climate and ice conditions.

Bowhead whales, which yield high volumes of oil, were highly sought by Indigenous and European whalers. The eastern stock of bowheads was largely depleted, primarily by Basque and other European whalers before 1850.[37] The focus of the harvest then shifted to the Pacific sector of the Arctic with an initial focus in the Bering Sea. In the 1860s, the whalers pushed farther north into the Chukchi Sea working between the pack ice and the shores of Chukotka and Alaska. An unexpected closing of the ice along the Alaska coast in late summer 1871, however, crushed 33 whale ships in the ice and contributed to the demise of the commercial whale harvest. Only with the adoption of steam-powered vessels in the late 1870s were the whalers able to transit the Beaufort Sea coast of Alaska in its brief open water period to reach the whales' summer grounds.[38] The fleet then overwintered frozen into ice between Herschel Island and the mainland and realized large harvests when the ice broke up and the whales arrived in the subsequent summer. The ships had to leave early enough, however, to traverse the Beaufort Sea coast again before ice closed the passage.

Commercial whalers also harvested too many walrus in the mid 19th century, a slaughter that was exacerbated by ships that were forced to linger in the northern Bering Sea while waiting for the ice to retreat and allow passage to Beaufort Sea whaling grounds.[39] That early summer ice was home to large numbers of walruses—mainly females and their dependent young—and the whalers killed many walruses while waiting for the ice retreat. In the 1870s, the whalers reduced the walrus population by half contributing to mass starvation of Indigenous people in the Bering Strait region in 1878 and 1879.

More recently, sea ice has also impeded offshore oil development in Alaska.[40] Modern observational and forecast systems lack the ability to produce timely and accurate forecasts of sea ice conditions at the small spatial scale needed to inform drilling and other commercial operations.[41] The prediction challenges have been heightened by the transition to an Arctic Ocean dominated by first-year ice, and new approaches, such as artificial neural networks, are being explored for making near-term predictions.[42] Similarly, without improved short-term sea ice forecasts, ship-based tourism will be vulnerable in the Arctic much as commercial whalers were in the 1870s.[43]

Arctic Climate in the Anthropocene

Scientists debate whether we should call the epoch in which we now live the Anthropocene, but there is very little debate that burning fossil fuels is warming the planet and driving the sixth major extinction of Earth's species.[44]

The burning of fossil fuels has led to a massive redistribution of carbon on the planet. Carbon accumulated from dead plants and animals has been locked up for thousands and millions of years in the form of peat, coal, and oil. Increased burning of those carbon-rich fuels in the past 250 years has released much of that carbon into the atmosphere. That accumulation of greenhouse gases in the earth's atmosphere is warming the entire planet, but the rate is accelerated in the Arctic by changes in the cryosphere.[45]

In recent decades, warming of the atmosphere and oceans has diminished the area of the Arctic covered by sea ice in summer by 50 percent, an environmental change so abrupt as to challenge the abilities of species and society to adapt. Where sea ice used to reflect most of the sun's energy, there is now unfrozen water which absorbs most of the sun's energy, thereby further heating the ocean and accelerating ice melt. Over the past three decades, the impact of the self-perpetuating warming in the Arctic was equivalent to 25 percent of the global warming from carbon dioxide accumulated in the atmosphere.[46] Warming is further accelerated in the Arctic by the physics of heat transfer at colder temperatures and by the temperature structure above the surface of the Arctic.[47]

The amplification of warming in the Arctic means that the region continues to warm at more than twice the global average rate, and the surface air temperature in the Arctic during each of the past six years has exceeded all previous records.[48]

Moreover, the Arctic appears not to have seen temperatures as warm as the past century in at least 44,000 years and possibly 125,000 years.[49]

The area of the Arctic Ocean covered by sea ice has shrunk in all seasons over the past 40 years and is smaller than any other time in more than 1,000 years.[50] The fraction of ice that persists beyond a single year before melting has declined from 60 percent to 30-40 percent in the last four decades.[51] The thinner first year ice is more vulnerable to rapid disintegration, contributing further to diminished ice coverage.[52]

With declining ice extent and thickness, the duration of the ice-covered season also has declined by 40 days since 1979 with regional variations. That seasonal decrease has diminished the period in which subsistence or commercial activities can safely take place on the ice, increased coastal erosion and marine shipping, and diminished access to subsistence food and on-ice travel for industrial development.[53]

Reduced sea ice cover allows increasing amounts of heat to escape the Arctic Ocean and warm the atmosphere above which, in turn, increases the amount of precipitation that falls as rain instead of snow.[54] The changing temperature and precipitation patterns are also reflected in ice sheet melt and permafrost thaw. The Greenland Ice Sheet is melting at accelerating rates and now is the greatest contributor to sea level rise as it was during past warm intervals.[55] At the same time, permafrost soils are thawing in the Arctic releasing additional greenhouse gases into the atmosphere.[56]

Arctic ecosystems are responding to the changing climate by shifting species composition and range. For example, over much of the Arctic, shrubs are becoming more dominant at the expense of grasses and sedges.[57] Shrubs and trees are likely to replace tundra plant communities over as much as half the landscape.[58] More wildland fires are increasing the fraction of deciduous trees in boreal forests, and such shifts in plant communities will alter the distribution and abundance of subsistence species such as moose, caribou, and musk ox.[59]

Marine ecosystems also are being reorganized by diminishing ice cover, warming temperature, and increasing acidity. The reduction in ice cover threatens the persistence of species that depend on ice as habitat and as protection from competitors and predators.[60] Warming Arctic Ocean temperatures are facilitating northward expansions of species from clams to whales.[61] At the same time, the ranges and population sizes of some northern species are shrinking.[62]

Oceans are acidifying as they absorb 20 to 30 percent of the carbon that we have emitted to the atmosphere.[63] The Arctic Ocean is especially vulnerable with the fastest rates of acidification likely in the Central Arctic Ocean, the Canadian Arctic Archipelago, and Baffin Bay.[64] Growth and survival of some Arctic zooplankton are impaired by acidification.[65] The combined individual responses of species to environmental changes are shifting the Arctic marine ecosystem toward boreal species. Arctic species are contracting northward and threatened with being out competed by species previously restricted to more southerly latitudes.[66] People who depend on the Arctic ecosystems are challenged to adapt to the rapid changes.[67]

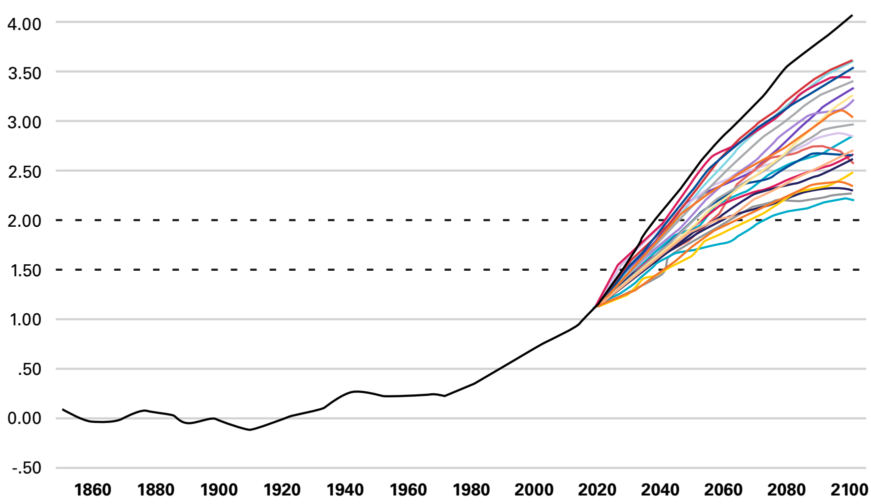
Future Arctic Climates

The Arctic climate clearly has been changing rapidly in recent decades, and predicting its future state is essential to understanding the threats and opportunities for people and other species in the Arctic and beyond. To a certain extent, we can look to past periods of climate change to inform predictions, but the devil is in the details. For example, the planetary warming in the Eemian, 125,000 years ago (Figure 1), in some ways represents an analogue for the current warming. Indeed, chemical analysis of sediment cores showed that the North Atlantic Ocean warmed considerably in the Eemian as it has recently, but the Arctic Ocean remained cold enough to form ice as a consequence of much greater freshwater input from the larger ice sheets that preceded the Eemian.[68]

The devilish detail in the Eemian example was the amount of freshwater input to the oceans from melting ice sheets. Modeling the climate without the impacts of that freshwater on freezing points and ocean circulation would miss major impacts on sea ice. Climate models are increasingly adept at considering the interaction of such details while replacing the "devil" with understanding. The models simulate the flow of energy through the atmosphere, hydrosphere, lithosphere, cryosphere, and biosphere using mathematical equations rooted in well-understood physics. The models are constantly refined, and they are increasingly skilled at prediction.[69] Climate modelers simulate future climates for an array of future emission scenarios (Figure 2). Standard scenarios include representative climate pathways (RCPs) with different levels of radiative heating:

- RCP2.6 would limit radiative heating this century to 2.6 watts/square meter of the planet's surface and could raise temperature by ~1.8 °F above pre-industrial levels;
- RCP4.5 would limit radiative heating this century to 4.5 watts/square meter, increasing temperatures by ~3.2 °F; and
- RCP8.5 would limit radiative heating this century to 8.5 watts/square meter, increasing temperatures by ~6.7 °F.

FIGURE 2: Smoothed average global temperatures, 1850–2100



Note: The smoothed average global temperatures (expressed as the difference from the average temperature between 1850 and 1899) were observed from 1850 to 2020 and projected by climate models from 2021 to 2100. Each color shows a different model projection, all based on "middle of the road" emissions and mitigation scenarios, with all exceeding by 2050 the 2°C (3.6°F) above pre-industrial levels specified in the Paris Climate Agreement. *Source:* Z. Hausfather.[70]

Limiting temperature increases to less than 2 °F (RCP2.6) would require eliminating carbon emissions and removing some of the greenhouse gases already in the atmosphere.

The amplification of warming through feedbacks (e.g., diminishing reflectivity from sea ice) means that, under all scenarios, the Arctic will warm much more than other regions in coming decades. Over 30 global climate models predict Arctic temperatures will stabilize at ~6.3 °F above pre-industrial levels later this century under RCP2.6. Under RCP4.5, they predict stabilization at ~9.9 °F above pre-industrial levels, but under RCP8.5, the models predict Arctic temperatures at the end of this century will be 18 °F above pre-industrial levels and will continue to rise.[71]

Unfortunately, historical emissions have been most consistent with RCP8.5, and we are likely to stay on this pathway at least until the middle of this century.[72] Observations and models make clear that the Arctic will continue to warm in the coming century and that the difference between socially and ecologically ruinous consequences depends primarily on the degree to which we lower carbon emissions. International syntheses based on observational and model studies included a focus on the polar region and highlighted the critical role of future emission rates.[73] To avoid the worst impacts, we will need to go beyond lowering emission rates and reduce the concentration of greenhouse gases already in the atmosphere.

Sea ice will persist, albeit in a diminished state, through the winters in this century with forecasted maximal coverage stabilizing at just under 14,000,000 square km under RCP2.6 and just under 13,000,000 square km under RCP4.5. In contrast, RCP8.5 is expected to reduce Arctic sea ice to a winter maximum of 10,000,000 square kilometers and to continue declining thereafter. Summer sea ice is expected to stabilize at just under 4,000,000 square km (about half of what was observed in the previous century) under RCP2.6 while dropping below 1,000,000 square km by mid-century under RCP8.5. More important for the Arctic marine ecosystem, national security, and many subsistence and commercial activities will be the duration of the open water period.[74] The duration of open water varies regionally. It began increasing in most regions of the Arctic Ocean in 1990 and will be outside the range of pre-industrial variability by 2050.[75]

Melting glaciers and icesheets will continue to add freshwater to the oceans throughout the century disrupting global climate through changes in the ocean circulation and rising sea levels. Disruptions to ocean circulation potentially will diminish productivity in the North Atlantic Ocean and alter rainfall and storm patterns around the world. In the last century, rates of sea level rise doubled and, in this century, they are projected to double again under RCP2.6 and triple under RCP8.5.[76] Globally, the sea level is projected to rise ~0.25 m under RCP2.6 and ~0.32 m under RCP8.5 in this century, but regional changes will vary depending on the relative movement of Earth's surface and on gravitation effects. Relative sea level rise will be greater in regions where the earth is subsiding and less where the earth is rising. Gravitational pull of large ice sheets raises the level of adjacent seas, thereby lessening relative sea level close to the ice sheets.

Nearly one-quarter of the lands in the northern hemisphere have underlying permafrost, but that area will diminish as will the depth of permafrost in the future.[77] Reductions in permafrost will continue throughout the century and beyond. And by 2300, as much as one-third of the permafrost area in the Arctic could be lost under RCP4.5 and 90 percent under RCP8.5.[78] When permafrost thaws, bacteria break down the remains of plants and animals releasing carbon dioxide and methane to the atmosphere, potentially further amplifying global warming. Under RCP8.5, those releases could be measured in hundreds of billions of tons. Carbon removed from the atmosphere through increased plant growth will likely only somewhat compensate for the releases. To refine the permafrost degradation projections, we will need improved assessment of current distribution as well as a better understanding of the impacts of increasing fires and processes leading to abrupt thaw.

The Path Forward

As the Arctic warms, its ecosystems will be further disrupted by changes in precipitation, temperature, pH, and ice cover. Before 2100, marine ecosystems will be altered primarily by warmer surface waters, increased acidification, reduced oxygen levels, and shifts in nutrient levels and patterns of primary production (creation of organic matter through photosynthesis). For example, by the end of the century, the frequency of marine heatwaves will increase 20 times under RCP2.6 and 50 times under RCP8.5 relative to 1850–1900 with the Arctic Ocean seeing some of the greatest increases. The combination of multiple stressors and rapid changes in climate will challenge society's and ecosystems' ability to respond.[79]

The rapid pace of environmental change in the Arctic begs the question, has or will the Arctic system transition to a new state or are the changes in recent decades within the range of previous natural variation of the system? A recent modeling study showed that the dramatic reductions in the extent of Arctic sea ice are indeed indicative of a new climate.[80] Under RCP8.5, the reduced ice cover will enhance warming of surface air temperatures, which are projected to emerge beyond previous variability in the first half of this century. The warmer air temperatures, in turn, will contribute to precipitation falling increasingly in the form of rain instead of snow, and that change will emerge beyond previous variability in midcentury.

Overall, these results suggest a transition from a cryosphere-dominated system; a defining characteristic of the Arctic with far ranging implications for people and species in the region. Emergence of this new Arctic—ice free for 3–4 months per year, winter air temperatures 29–50 °F warmer, with the rainy season extended by 2–4 months—could be avoided or, at least, postponed by reducing greenhouse gas emissions.

In just over 200 years of burning fossil fuels, our species has gone from evolving in the context of earth's climate to profoundly altering that climate; now, we are establishing the context to which we and other species will have to adapt or perish.[81] The pace of the environmental changes is outstripping the adaptive capacities of many species. Our changed relationship to the climate system is as if the climate snake is now eating its tail as did the carbon snake of Kekulé's dream. His vision yielded a sudden insight that advanced knowledge of carbon chemistry. Scientists today are advancing understanding of carbon's role in climate, but the insights cannot come too quickly. Perhaps, we should hasten the pace of understanding Arctic change by "learning to dream" as Kekulé exhorted his peers.

Recommendations for the U.S. Administration and Congress

Strengthen the Paris Climate Agreement. In the Paris Climate Agreement, 195 countries agreed to find measures to limit global temperature rises to less than 3.6 °F above pre-industrial levels. The United States unilaterally withdrew from the Agreement in 2020 and rejoined in 2021. A global effort will be required to meet the Agreement's goals, and leadership by the United States, the world's second largest emitter of greenhouse gases, will be essential. Limiting temperature increases to 3.6 °F above pre-industrial levels will require political and technological advances.

Depoliticize understanding of climate change. Tribalism explains more of the variation in perceived risk from climate change than does science literacy.[82] Political and educational leadership is needed to garner the support needed for measures addressing the threats of climate change.

Establish a strategy for equitably transitioning to a carbon neutral energy system. Transitioning away from fossil fuel energy sources will burden some sectors and communities and benefit others in terms of employment and health. Equitable distributions of burdens and costs will be critical to a successful transition.

Account for the climate costs of new infrastructure investments. Maintenance of physical infrastructure will increase substantially as the climate changes. Accounting for and mitigating those costs in advance—especially in the Arctic where change is especially rapid—can substantially lower costs.[83]

Put a price on carbon. Whether through a tax on carbon or an emissions trading system, carbon pricing (e.g., H.R.763 - Energy Innovation and Carbon Dividend Act of 2019) will help reduce emissions while stimulating technological and market innovations.[84]

Accommodate climate refugees. The United Nations anticipates at least 50 million climate refugees by 2050.[85] An international agreement needs to be enacted to establish a legal convention for resettling climate refugees in responsible countries considering relevant social, cultural, and ecological aspects.[86]

Lead world in transition to alternative energy. The United States should invest in research to help renewable energies meet the demands of growing populations and economies.[87] Relying on renewable energy will require innovations in managing power generation, transmission and distribution, storage, and demand.

Develop effective sequestration of carbon. Limiting temperature increases to well below 3.6 °F will be necessary to avoid surpassing dangerous tipping points with respect to melting land and sea ice in the Arctic.[88] Meeting such a target will require removal of carbon from the atmosphere, and substantial research investments are needed to develop effective methods.[89]

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Arctic summer and icebergs in the blue sea, world heritage Ilulissat icefjord in the Disko Bay in Greenland *Source*: By Friederike K / Shutterstock.com

COMMODITIES

Image source: View over the stone coal mine in the Russian settlement called "Barentsburg" on Spitsbergen. By Sandra Ophorst / Shutterstock.com

By Dr. Mark D. Myers

Navigating the Future of Commodities in the Arctic

The Export of Commodities is an Essential Element of Arctic Economies

The Arctic is rich in known and potential renewable and non-renewable resources. The distribution of these resources is determined by the complex geology, geography, and ecology of the region. Integrated assessments of the yet to be discovered resource base in the Arctic are few and uncertain due to many factors including remoteness, ice cover, lack of access, and the high cost of research and exploration. However, the assessments generally indicate high potential for abundant yet to be discovered world-class resources in many parts of the Arctic. The Arctic's rich endowment of both proven and potential natural resources presents a strategic target for resource exploitation both by Arctic states and other industrialized countries.

While Arctic states employ different economic strategies, they generally support increased resource development if it can be done in a way that is sustainable and the negative environmental and social impacts can be mitigated. Commodities are a major source of direct and indirect benefits to the Arctic states and their communities, while also having possible negative impacts. In addition to royalty and tax revenues, other major benefits include employment of citizens in the extraction industries and associated processing and service industries and the development of associated power generation and distribution networks, transportation infrastructure, and communication networks. In 1996, the eight Arctic states formed the Arctic Council with the goal of creating a mechanism to oversee and coordinate sustainable development, taking into account issues such as increases in shipping, petroleum activities, fishing, and mining as well as external influences such as climate change and variability.[1, 2]

In large parts of the Arctic: remoteness, extreme environmental conditions, lack of access and infrastructure, and high cost of natural resource development have been major limiting factors to the exploitation of commodities. As a result, the Arctic remains underexplored and underdeveloped compared to most other regions of the world.

This chapter looks at four major commodity types: (1) oil and gas, (2) strategic and critical minerals, (3) fish, and (4) wood. It also briefly explores the role of two disruptive forces that will likely appreciably impact future resource development and commodity export in the Arctic. These are: (1) the rapidly changing climate and the associated rapid loss of seasonal sea ice, and (2) advancements in technologies that will increase the efficiency and improve the economics of Arctic resource development. Other key factors that will strongly influence future commodity development in the Arctic include: (1) a tremendous resource base including world-class fisheries, oil, gas, mineral and wood resources; 2) increased demand for commodities driven by worldwide population growth and the economic expansion of non-OCED countries; 3) increased demand for strategic raw materials needed for newer and developing technologies; 4) decreased access to raw materials elsewhere, (due to depletion, environmental and societal restrictions, or international conflict) and; 5) strategic investments by Arctic governments in transportation and communication networks within or from Arctic countries that will improve access to economic resource development opportunities in remote parts of the Arctic. An example of strategic investment is Russia's efforts to expand the Northern Sea Route, which includes integrating the marine transportation system with in-situ processing facilities, port, power, pipeline, railroad, communications, and road infrastructure.

Current Commodity Exports from Arctic States

The development and export of commodities, along with tourism, public administration, education, and defense, constitute much of the economic activity taking place in the Arctic region. Currently, large-scale commodity export from the Arctic continues to focus on oil and gas, metals and precious stones, seafood, and, to a lesser extent, wood. The mix of commodities produced and exported by Arctic states varies significantly. In Alaska, the largest value export commodity is oil and gas, followed by seafood and metals. In Arctic Russia, the highest value Arctic export commodity is oil and gas, with significant exports of metals, wood, and, to a lesser degree, fish. Canada's commodity export from the Arctic is primarily precious stones and metals, and in Norway, it is oil and gas, followed by seafood and raw aluminum. For Iceland and Greenland (Autonomous region of Denmark), fish is the primary commodity export, making up 40 percent and 90 percent of their respective export revenue revenues.[3] In Sweden and Finland, raw material exports make up only a small percentage of the exports with wood and iron ore being the largest.[4, 5]

Oil and Gas Resources of the Arctic

Four of the eight Arctic states: Russia, Alaska, Canada, and Norway, have large proven oil and natural gas resources at locations that are north of the Arctic Circle. More than 400 oil and gas fields have been discovered north of the Arctic Circle in on-shore locations in Canada, Russia, and Alaska. Large Arctic oil and natural gas discoveries began in Russia in 1962, with the discovery of the Tazovskoye Field, followed in 1967 by the discovery of the Prudhoe Bay Field on the North Slope of Alaska.[6] In 2015, the total cumulative production of oil and gas from the Arctic was an estimated 117 BBOE (billion barrels of oil equivalent) which represents just 14 percent of the endowment. Another 191 BBOE, or 23 percent of the endowment, was in yet-to-be-produced reserves; 99 BBOE, or 12 percent, was discovered but not yet considered reserves; and

426 BBOE, or 51 percent, was yet to be discovered (see endnote 12). Since 2015, and despite the dramatic fall in crude oil prices, 47 Arctic exploration wells have been drilled and 5 billion barrels of discoveries announced.[7]

Undiscovered Oil and Gas Resource Potential

There remains much uncertainty about the distribution and amount of undiscovered oil and gas resource base in the Arctic due to the overall lack of geotechnical information, particularly geologic data from exploration wells. For example, even in some of the most explored basins such as the North Slope of Alaska, the density of exploration wells drilled is about three wells per 1,000 square miles as compared to 250 wells per 1,000 square miles in the petroleum basins of Wyoming.[8] In several large Arctic basins, only a few or no exploration wells have been drilled. However, in many of these underexplored basins, the key geologic elements of source rock, reservoir, and large geologic structures have been identified.

In 2008, the United States Geological Survey completed a systematic, probabilistic-based assessment of the conventional, technically recoverable, and undiscovered resource base of the 6 percent of the earth's landmass that is north of the Arctic Circle. The sum of the mean estimates for all geologic provinces was 90 billion barrels of oil, 1669 trillion cubic feet of gas, and 44 billion barrels of natural gas liquids. These mean undiscovered resource numbers equal 13 percent of the world's estimated undiscovered conventional oil and 30 percent of the estimated undiscovered conventional gas. Eighty-four percent of this undiscovered resource base was estimated to be offshore. More than 70 percent of the undiscovered oil was estimated to be in five provinces: Arctic Alaska, Amerasian Basin, East Greenland Rift Basins, East Barents Basins, and West Greenland-East Canada. More than 70 percent of the undiscovered natural gas was estimated to occur in three provinces: the West Siberian Basin, the East Barents Basins, and Arctic Alaska.[9]

Climate Change's Effect on Arctic Oil and Gas

Rather than being somewhat homogeneous, the Arctic has substantial variations in ecosystem properties that affect both our ability to extract oil and gas and the specific positive and negative impacts from climate change. For example, continuous permafrost in the onshore and nearshore environments dominates much of the Arctic in Western Canada, Alaska, and Western Russia. As permafrost thaws this creates challenges for onshore infrastructure including pipelines, drill sites, gravel and ice roads, surface water supplies, processing facilities, and ports. It is estimated with medium confidence that by 2050, 70 percent of Arctic infrastructure will be in regions at risk from permafrost thaw and subsidence.[10]

Increase in seasonal sea ice along the coastline augments wave energy and shoreline erosion but provides longer periods of ice-free conditions which allows for better marine access and a longer shipping season. In Arctic Alaska, Canada, and large parts of Arctic Russia, this change will dramatically improve the economics of transporting natural gas and oil by ship directly from the Arctic to global markets, eliminating the need for new long-distance pipelines. In contrast, the southern coastal and offshore regions of Barents Sea off Norway are ice free with the Northern Barents having seasonal winter sea ice which is expected to decrease in extent and thickness due to climate change. Thinning sea ice in these areas should improve access for offshore development but it may not significantly improve development economics.[11]

As in other areas of the world, climate change policy will affect the development of Arctic oil and gas. Arctic states and investors will consider the impacts of new hydrocarbon production on greenhouse gas emission reduction commitments. This could affect the willingness to finance or approve new greenfield projects. Additionally, policies favoring non-hydrocarbon-based energy resources will ultimately decrease world-wide demand for oil and gas. The timing of this energy source transformation is likely to have the most dramatic effect in areas of the Arctic that are yet to be explored or in the early stages of exploration.

Technological Innovation that will Improve the Economics of Arctic Oil and Gas

Given the high cost of exploration, development, and transportation, Arctic oil and gas development requires giant and supergiant fields to justify the costs of greenfield development. These projects are often very innovative and incorporate significant technological advancements from previous projects. This new infrastructure and technology strategically anchors long-term development in these prolific hydrocarbon basins.

However, once the development is anchored by a major field or fields - incrementally smaller fields can become economical. Anchor fields are present in Arctic Russia and Alaska and to a lesser extent in the Barents Sea off Norway. New development is currently ongoing in 2021 in all three areas and successful in part because oil and gas exploration and development technologies appropriate to Arctic development have been steadily advancing.[12] Some areas of advancement include dramatic improvements in seismic acquisition, processing and interpretation, drilling and logging, completions, drilling, blowout prevention, well control and oil spill clean-up structures, modular facilities instructions, safety and monitoring systems, production systems, pipelines, and loading systems. Throughout the exploration, development and production lifecycle, extensive use of automation and autonomous systems is becoming common place. This technology is greatly reducing the number of people required onsite, improving efficiency and lowering cost. In new high-potential and high-risk areas such as offshore Greenland that lack the discovery of a known anchor field, future development is more uncertain.

Mining in the Arctic

The Arctic is rich in critical and strategic minerals with iron ore, nickel, bauxite, copper, lead, phosphate, platinum, rhodium, cobalt, silver, and zinc being actively mined. There is also large-scale mining of coal, silver, gold, and diamonds. Significant deposits of other minerals including gold, rare earth minerals, graphite, tin manganese, chromium, antimony, tungsten, barium, and mercury are also present in the Arctic. Mining is a significant economic driver of jobs and export income in Arctic Russia, Alaska, and Canada. It is a well-established industry in Norway, Sweden, and Finland. All these countries plus Greenland have large endowments of discovered and yet-to-be-produced mineral deposits as well as geological indicators of significant yet-to-be discovered mineral endowments. For example, Norilsk Nickel in Russia is the third largest nickel and second largest platinum and palladium producer in the world, and the Red Dog Mine in Alaska is by volume the second largest zinc mine in the world. Together, Sweden and Finland produce more than half of the metal production of the European Union.[13, 14]

Efforts to develop new mines continue. For example, two mines are in development in Greenland, three in Northern Canada, and one in Alaska.[15] The Pavlovskoye mine being developed on Novaya Zemlya will be the northernmost and the fifth largest polymetallic mine in Russia.[16] Many of these new mines will require extensive supporting infrastructure and Arctic state governments often support the development of this infrastructure. For example, the state of Alaska is advancing the development of the road infrastructure to open up the Ambler mining district on the southern flank of the Brooks Range in order to access four deposits with world-class resources of copper, zinc, lead, plus associated silver and gold.[17] In Russia, port and near-mine infrastructure development coupled with significant investment in the Northern Sea Route are being used to increase both minerals and oil and gas production in the Arctic. The Northern Sea Route infrastructure being planned not only includes the icebreaker fleet and trans-shipment terminals but also new roads, railway lines, airports, and electric power and communications infrastructure.[18]

Technology and Arctic Mining

Arctic mining will benefit from several major areas of technological advancement. While these advantages universally improve mining efficiency and economics, they could disproportionately improve the competitiveness of Arctic mining where there are extreme environments, vulnerable ecosystems, little infrastructure, large distances to markets, little exploration data, and high labor costs. For exploration, these advancements include significant advancements in remote sensing and geochemical analyses including airborne gravity gradiometry; multispectral into hyperspectral remote sensing; deeper electromagnetic survey including airborne; 3D electric and electromagnetic survey; 2D into 3D modeling and inversion; and portable mineralogical and geochemical analyzers, including portable X-ray fluorescence and laser fluorescence scanning. The ability to perform airborne remote sensing using autonomous drones lowers costs, decreases risk to personnel, and allows for repeat, highly detailed surveys. During the development and production phases, autonomous vehicles and drillers coupled with autonomous drones and sophisticated in-situ sensor systems linked through geographic information data management systems can be used for monitoring, safety, and surveillance; asset management; infrastructure; remote sensing for environmental management, and resource assessment.

Climate Change and Arctic Mining

Climate change will create both opportunities and challenges for Arctic mining. Opportunities include increased marine access to the proximity of mine sites due to decreasing seasonal sea ice. This is critical both for moving equipment, fuel, and supplies to the mine sites and also for transportation of ore concentrate to processing facilities. Decreasing terrestrial ice will provide access to new exploration areas. On the negative side, thawing permafrost and slumping, increased fire, changes in the availability of surface water, and coastal erosion will create challenges to mining and support infrastructure, tailings storage and dam safety, erosion control, water management, environmental protection, and mine site reclamation.[19]

Arctic Fisheries

Arctic marine waters contain a wide range of ecosystems with many different types of fisheries including some of the world's most productive fisheries along with large areas of low productivity. The productivity varies due to variations in subsea topography, ice conditions, temperature, currents, circulation patterns, stratification, associated primary and secondary productivity, and other factors. The major fisheries include: (1) the Bering Sea (North Pacific), (2) the Barents and Norwegian Seas (Northeast Atlantic), (3) the Labrador Sea and Baffin Bay (Northeast Canada) and (4) the Greenland Sea (Central North Atlantic). While individual states have taken somewhat different approaches to managing their marine fisheries, they have generally collaborated with bilateral or multilateral science, monitoring, and management agreements that recognize the need for sustainability and science-based management.[20] Notable examples, include the Bering Sea where the United States and Russia have since 1988 coordinated fisheries research and consulted in fisheries conversations and management through a bilateral agreement. Another example is the Barents Sea where Norway and Russia are managing the fisheries through joint cooperative mechanisms.[21, 22]

In Alaska, the commercial fishing and seafood processing industry is its largest employer and the value of the state's seafood exports is second only to oil and gas. The U.S. portion of the Bering Sea including the Aleutian Islands, produces 59 percent of the value of all fish and shellfish produced in Alaska. The Dutch Harbor by volume of fish landed is the largest seafood port in the United States.[23] North of the Bering Straits, the U.S. government has established the Arctic Exclusive Economic Zone (AEEZ), which includes the Chukchi Sea and the Beaufort Sea. The U.S. government recognizes that the changing ecological conditions, including loss of seasonal ice cover and warming conditions, may increase the productivity of fisheries and could allow for commercial fisheries in the AEEZ. However, commercial fishing will remain prohibited until there is sufficient scientific data to demonstrate that future commercial fisheries could be run sustainably.[24] In addition to the federal waters of the Arctic, the state of Alaska manages numerous commercial fisheries within three miles of the coastline. These include a small chum salmon commercial fishery north of the Bering Straits in the nearshore waters of the Chukchi Sea, and a small finfish fishery on the Colville River.[25]

Protection of the High Central Arctic Ocean

In 2018, all the Arctic nations plus China, South Korea, Japan, and the European Union agreed to the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (CAO). The Agreement bars unregulated fishing in the high seas of the CAO for 16 years and establishes a joint program of scientific research and monitoring to gain a better understanding of Arctic Ocean ecosystems. It also authorizes vessels to conduct commercial fishing in the CAO only after international mechanisms are in place to manage any such fishing. This effort marks the first time an international agreement of this magnitude has been proactively reached before any commercial fishing has taken place in the high seas.[26]

Climate Change and Arctic Fisheries

Rapid warming of the Arctic is significantly affecting the Arctic marine ecosystem including by decreasing sea ice, increasing fresh water (decreasing salinity), increasing ocean acidification, and increased wave energy. For Arctic marine fisheries, this will result in significant changes in species distributions, yield, and timing of production. Commercially important fish species may expand in distribution and abundance. The decrease in sea ice will also improve access for fishing vessels. However, negative impacts are also likely. For example, in the Bering Sea, the National Oceanic and Atmospheric Administration predicts that the northward shift of sea ice will result in at least a 40 percent reduction of pollock.[27]

Technology and Arctic Fisheries

Technological advances are rapidly improving the ability to monitor not only arctic marine ecosystems and fisheries but also the efficiency and economics of the fishing fleet.

Some that will improve our observation and understanding of marine ecosystems and fisheries include remote sensing from autonomous underwater surface and airborne platforms, animal-deployed sensors, genomics, electronic reporting, expendable ice tracking for under-ice data collection, and advanced microsensors for measuring water properties. A continuing technical challenge involves the integration of data from these new platforms and sensors to create tools to monitor and help manage the Arctic's annual multi-billion-dollar commercial fishing industries.[28]

Within the fishing fleet, technological improvement can be conceptually separated into two groups: (1) major improvements in gear design, fish finding, and catch handling that are implemented throughout a fleet within a few years; and (2) small background alterations in the rigging of a vessel or the skill of skippers at handling new technology or applying information technology. So far, mechanisms such as GPS, fish finders, echo-sounders, or acoustic cameras have led to an average 2 percent yearly increase in boats' capacity to capture fish.[29]

Forestry in the Arctic

The boreal forest extends across Russia, Alaska, Canada, Norway, Sweden, and Finland from 50 degrees to 70 degrees North latitude and contains about one-third of the world's forest cover. Boreal forests are dominated by spruce, larches, and firs but also contain poplars and birches. Today the boreal forest supply makes up about 45 percent of the global softwood production.[30] Practices for sustainable yield of timber harvest in the boreal forest varies across the Arctic. For example, in Norway, Sweden, and Finland, most of the old growth forests have been replaced by managed forests with stocking and growth targeted for sustainable growth. But in Alaska, much of the boreal forest timber harvest comes from intact natural forest where post-logging regeneration involves natural processes. As a result, the harvest practices and sustainable yield of the forests are different.

Climate Change and Forest Management in the Arctic

Throughout the Arctic, sustainable forest management will need to consider the effects of climate change on the boreal forest biome. Warmer temperatures, changes in the timing of moisture delivery, increased fire and insect disturbance, biome shifts, and changes in species compositions are all occurring. These changes will ultimately affect the volumes, quality, tree sizes, and species compositions within the boreal forest. While climate change will create opportunities for salvage logging or selective thinning as a method of fuel management, it also may lead to an overall reduction of harvestable timber volumes.[31, 32, 33]

The boreal forest has historically acted as a significant terrestrial carbon sink and an important source for future carbon sequestration. However, recent research suggests that the climate-driven increase in fire frequency and severity threatens to shift the boreal ecosystem from net carbon accumulation to net carbon loss.[34]

Technological Innovation in Forest Management

The timber industry and forest management in general is benefiting from the use of airborne Light Detection and Ranging (LiDAR), a remote sensing method that uses laser return times and frequencies to map surfaces with great accuracy. LiDAR surveys provide highly accurate bare earth digital terrain data as well as a three-dimensional image of the forest canopy down to the level of individual trees. This makes LiDAR a powerful tool for forest management at many scales. Because LiDAR can be flown using drones, aircraft, or helicopter and can be flown over large remote areas, it is particularly valuable in remote, hard to access areas with extreme climates and rugged terrain that lacks infrastructure. Once a baseline survey is established, it is also a powerful tool for assessing change in forest conditions. These attributes make LiDAR a powerful tool for managing Arctic forests for sustainable forest and sustainable yield.[35]

The Path Forward

Arctic States will continue to expand the development and export of their proven natural resources including oil and gas, metals, and precious stones, and if it can be done sustainably, fish and wood. Despite significant historic production of oil and gas and mineral resources, exploration for these resources is still in the early stages. To date, only a small portion of the potential economic endowment has or is being produced. Both the fisheries and timber stocks are being affected by climate-induced ecosystem change; a significant factor that will influence how commercial harvest levels change in the future. For all four commodities, new technologies are allowing for better resource assessment and management and may increase the efficiency of and decrease the personnel needed for extraction or harvest. Decreasing sea ice will in many cases enhance accessibility, making it easier and more economical to explore, develop, and transport these resources.

Source: By SchnepfDesign / Shutterstock.com

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Dr. Mark Myers has been engaged in arctic research, resource management and policy for nearly four decades. He holds BS, MS, and PhD degrees in geology. He is the principal of Myenergies and is currently engaged, through Deloitte and the US State Department, in overseas capacity building in government resource ministries in the Arctic and Eastern Europe. Previously, he served in senior leadership positions with the State of Alaska, University of Alaska, and the U.S. Department of Interior. These positions included Director of the U.S. Geological Survey (USGS), Alaska Commissioner of Natural Resources, Vice Chancellor for Research at the University of Alaska Fairbanks, Alaska State Geologist and State Director of Oil and Gas. He has served on multiple advisory committees for the Department of Energy including the National Petroleum Council and the Methane Hydrate Committee. He has also been involved with the Arctic Council, serving as a member of the US Delegation for the 2015 Arctic Council Senior Arctic Officials Meeting and as member of the US delegation to the Sustainable Development Working Group and the Scientific Cooperation Task Force. While Director of the USGS he served as a principle on the steering committee for US Global Change Research Program and a member of the US Interagency Arctic Research Policy Committee.

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COMMERCE

Winter aerial view of a container ship loading at an Arctic port.
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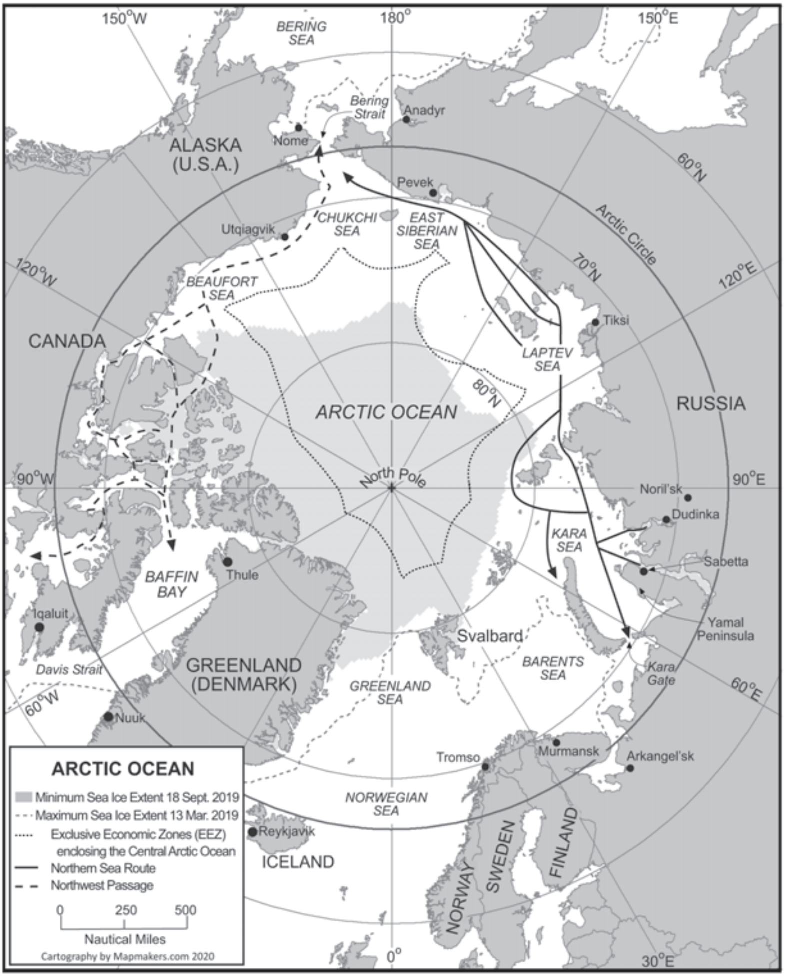
By Dr. Lawson W. Brigham

Navigating the Future of Commerce in the Arctic

The Arctic is principally an ocean, so it makes common sense that marine commerce is integral to the economy of the North and to supporting coastal communities. Marine commerce is facilitated by: advanced transportation systems tied to Arctic natural resource development; coastal and offshore fishing vessels; summer supply vessels supporting northern communities; and, a wide variety of specialized vessels operating in coastal Arctic waters (including cruise ships, icebreakers, small container ships, tug-barges and supply ships). Historic, ongoing environmental changes in the Arctic in response to a warming planet, *and* the development of the Arctic's untapped storehouse of natural resources (oil, gas and mineral wealth) are driving use of the Arctic Ocean for expanded commercial operations with a resulting increase in marine traffic. The profound retreat of Arctic sea ice observed during the past five decades provides for greater marine access, but not necessarily year-round access, and potentially longer navigation seasons. However, it has remained challenging to quantify this greater access and determine the practical (and economically viable) length of the navigation season, given the array of variables and uncertainties involved.

The major Arctic marine transportation systems being developed today are heavily influenced by the volatility of global commodities prices *and* the pace of Arctic natural resource development. Visions of future trans-Arctic voyaging across Russia's Northern Sea Route (NSR), or even across the Central Arctic, are tempered by the fact that the Arctic Ocean is fully or partially ice-covered during autumn, winter and spring in this century. The seasonality of potential navigation seasons (not normally year-round) and the vagaries of the Arctic's weather constrain routine and large container ship operations in a future Arctic Ocean. Currently the vast majority of commercial marine traffic is destinational. Examples of this commercial trading include: ships sailing in and out of Arctic waters to carry natural resources (oil, gas, minerals, and fish) to global markets; conducting voyages for marine tourism; supporting offshore oil and gas development; and delivering goods and services to Arctic coastal communities during summer (and largely ice-free) navigation seasons. None of these marine operations require trans-Arctic routing.

FIGURE 1: Map of the Arctic Ocean indicating the marine routes of the Northwest Passage and Northern Sea Route.



Source: Author and Cartography by Mapmakers.com 2020.

Geography and Current Marine Traffic

Arctic commerce is influenced by the complex physical geography of the Arctic and high latitude climatology of the region. Dominant features that affect marine navigation and governance include: large archipelagoes with straits in the Canadian and Russian Arctic regions; a broad continental shelf along the Eurasian coast of the Arctic Ocean; shallow coastal seas; a narrow international strait in and out of the Pacific Ocean (Bering Strait); and extremely cold temperatures with a completely ice-covered sea during long, dark winters.[1] Figure 1 illustrates the positions of the Arctic states surrounding the Arctic Ocean and its coastlines, and the boundary of the Central Arctic Ocean (CAO), which is created by the 200-nautical mile Exclusive Economic Zones (EEZs) of the five Arctic Ocean coastal states (Canada, Denmark/Greenland, Norway, Russia and the United States). The CAO is a high seas area and global commons (for navigation and fishing) that remains challenging to reach by surface ship even during the late summer when a minimum coverage of Arctic sea ice attained.

The map also indicates the positions of the winter maximum (March 13) and minimum (September 18) extents of sea ice for 2019. During this winter, the multiple routes within the Northwest Passage (NWP) and Northern Sea Route (NSR) were ice-covered for approximately eight months. Several key ports remained relatively ice-free at the time of maximum extent: Nuuk, Greenland; Reykjavik, Iceland; Longyearbyen, Svalbard; Tromsø Norway; and Murmansk, Russia. During late summer at the minimum sea ice extent, the entire NSR is ice-free, but large areas of the Canadian Arctic straits remain clogged with ice; the CAO is also ice-covered except for a western area that faces the Bering Strait. Marine commercial traffic including marine tourism was at its height during this period of ice-free access throughout the Arctic Ocean.

The importance of gaining a current snapshot of Arctic marine traffic is highlighted in the diverse data in Table 1. The most significant traffic in early 2020 is related to commercial development of the Russian Arctic and operations along the NSR. For the six-month period from January to June 2020, 71 vessels made

TABLE 1. Key Arctic Marine Traffic Data

NORTHWEST PASSAGE[A]

- 319 Complete Passages (ocean to ocean) Through the Canadian Arctic Archipelago from Baffin Bay to Bering Strait (1906-2020).
- Summer 2010-2020 Navigation Seasons Full Transits: 2010 (12); 2011 (13); 2012 (20); 2013 (19); 2014 (10); 2015 (16); 2016 (18); 2017 (32); 2018 (2); 2019 (24); 2020 (6).

CENTRAL ARCTIC OCEAN NAVIGATION BY ICEBREAKER[B]

- 149 Icebreaker Transits to the North Pole (1977-2020): Russia (125); Sweden (9); Germany (6); USA (4); Canada (4); and Norway (1).
- First Icebreaker Voyage to the North Pole by the Soviet Nuclear Icebreaker *Arktika* on 17 August 1977.
- Only Late Winter/Spring (Non-Summer) Voyage to the North Pole by the Soviet Nuclear Icebreaker *Sibir* on 25 May 1987 (Voyage Duration 8 May – 19 June 1987).
- 7 Trans-Arctic Voyages by Icebreaker Via the North Pole (1991, 1994, 1996 and 2005).

RECENT NORTHERN SEA ROUTE TRAFFIC[C]

- Traffic January – June 2020: 71 vessels on 935 voyages: LNG carriers (257); Oil tankers Ob Gulf (228); Nuclear icebreakers (123); Norilsk Nickel carriers (79); Gas condensate carriers out of Sabetta (27); Research (1); Others including icebreakers, SAR vessels, tugs, general cargo ships (220).
- Total Cargo Increases Along the NSR: 2020 (32.9 Million Tons); 2019 (31.3 Million Tons); 2018 (18.7 Million Tons); and, 2017 (10.7 Million Tons).
- NSR Transits: Full NSR Transits & Northeast Passage/Trans-Arctic Voyages: 2020: 64 Transits (45 Trans-Arctic); 2019: 37 Transits (21 Trans-Arctic); 2018: 27 Transits (16 Trans-Arctic); 2017: 27 Transits (14 Trans-Arctic).

ARCTIC COUNCIL PAME ARCTIC SHIPPING DATA (2013-2019)[D]

- During 2019, 1628 vessels entered the IMO Polar Code Arctic Area; 41% or 671 were fishing vessels; other vessel types include: general cargo ships (174); bulk carriers (106); cruise ships (73); crude oil tankers (26); chemical tankers (60); container ships (6); gas tankers (24); offshore supply ships (45).
- Number of ships in the IMO Polar Code Arctic Area increased from 1298 unique ships in 2013 (total distance sailed was 6.51 million nautical miles) to 1628 unique ships in 2019 (total distance sailed was 9.5 million nautical miles).
- Number of ships in the IMO Polar Code Arctic Area in September (month of the minimum extent of Arctic sea ice): 2019 (977); 2018 (879); 2017 (909); 2016 (926).

SHIP TRAFFIC DATA FOR THE BERING STRAIT[E]

- Ship traffic northbound, southbound and total: 2014 ~ 130+125=255; 2015 ~ 232+220=452; 2016 ~ 158+182=340; 2017 ~ 164+196=360; 2018 ~ 183+175=358; 2019 ~ 248+246=494.
- Maximum number of ships in Bering Strait on one day, 2 September 2019: 10 (3 on the Russian side and 7 on the U.S. side).

Sources of Data:

a. R.K. Headland, Scott Polar Research Institute, Cambridge University, UK.
b. R.K. Headland and L.W. Brigham (author).
c. Nord University, Centre for High North Logistics, Norway.
d. Arctic Council PAME – Arctic Shipping Status Report #1, 31 March 2020.
e. Marine Exchange of Alaska, Juneau,

a remarkable 935 voyages; all of these marine operations were conducted in ice-covered waters.[2] A majority of these ships (liquefied natural gas carriers, tankers and bulk carriers) were sailing on destinational voyages carrying natural resources (oil, gas, gas condensate, nickel, and more) out of western Siberia from the Ob and Yenisey gulfs along the NSR to global markets. What's notable are the increases in cargo tonnages along the NSR from 10.7 million tons to 32.9 million tons between 2017 and 2020.[3] The Arctic Council also reports that in 2019, 1,628 vessels entered the Interntaional Maritime Organization Polar Code Arctic Area: 41 percent were fishing vessels (671); 396 were large commercial carriers (only 6 of these were container ships); 73 were cruise ships of varying size; and 45 were Arctic offshore supply/support ships.[4] Two major Arctic mines in Canada and Alaska are serviced by large bulk carriers and contribute to the statistics: the Red Dog Mine in the Chukchi Sea produces high grade zinc ore and exports to Pacific markets (20–30 bulk carriers visit annually in an ice-free season of 90–100 days); and Baffinland Iron Mines produces high grade iron ore and exports from Milne Port to European markets (70 to 75 voyages annually during a 4- to 5-month season).

The numbers of trans-Arctic voyages in 2019 along the NWP and NSR are more modest: 24 complete voyages during the NWP navigation season between Baffin Bay and the Bering Strait (5 large commercial ships, 5 passenger vessels, and 14 yachts/adventurers) and only 6 in 2020 (5 cargo ships and a single yacht). Commercial ships in 2020 made 64 complete transits of the NSR, but only 45 were trans-Arctic or ocean-to-ocean voyages; the other 19 voyages were in cabotage or traffic internal to the Russian maritime Arctic).[5] It is important to keep these voyages in perspective. Historically (1906–2020), there have been only 319 complete NWP trans-Arctic voyages, and through 2019, there have been only 7 trans-Arctic voyages by surface ship across the Arctic Ocean through the North Pole (all conducted by large nuclear and non-nuclear icebreakers between 1991 and 2005).[6] For comparison, in 2019 the Suez Canal Authority reports 18,880 transits (5,375 were large container ships) and the Panama Canal saw 13,785 total vessel transits (12,210 were oceangoing commercial ships).[7]

Russia's Northern Sea Route and Marine Commerce

Russia's Northern Sea Route (NSR) is a 'National Arctic Waterway' extending from Kara Gate (located at the southern tip of Novaya Zemlya) in the west to Bering Strait in the east, a length of 2800 nautical miles and crossing seven time zones (see Figure 1). The NSR maritime space, or 'Water Area' as designated by the Russian law, encompasses the coastal seas (Kara, Laptev, New Siberian and Chukchi seas) and marine routes within the 200-nautical mile Exclusive Economic Zone of the Russian Federation. However, the Barents Sea is not included in the legal definition of the NSR. Thus, a full transit of the NSR is *not* a full trans-Arctic voyage (Pacific to Atlantic oceans or vice versa) across the entire Russian maritime Arctic. The appropriate historic name for such a trans-Arctic voyage across the northern coast of Eurasia is the Northeast Passage.

The primary driver of the need for an effective northern marine highway is the development of Russian Arctic natural resources. The NSR provides increasing marine access to a vast storehouse of Siberian natural resources and Arctic routes to global markets in Europe and the Pacific. The key marine regions for current operations are in Western Siberia to the ports of Sabetta and Novy Port on Ob Bay, and the port of Dudinka on the Yenisey River. New liquefied natural gas (LNG) facilities on the Yamal Peninsula produce product for export that is loaded on icebreaking LNG carriers at Sabetta. Novy Port, an offshore terminal in southern Ob Bay, loads oil to small (shallow draft) tankers for shuttling to terminals in Murmansk. The port of Dudinka services the large mining and industrial complex at the Arctic city of Norilsk. The company Nornickel produces 20 per cent of the world's nickel and its mine holds half of the world's palladium, and significant deposits of copper and platinum. Norilsk is linked by rail to Dudinka where five icebreaking container ships routinely carry nickel plates and other products year-round to Murmansk and in a summer navigation season east to markets in the Pacific.

Recent NSR traffic data in Table 1 indicates the rapid increases in annual cargo tonnages along the Route from 10.7 million tons in 2017 to 32.9 million tons in 2020. The overwhelming number of ships along the NSR today are on domestic voyages (cabotage or internal voyages) and on destinational voyages carrying natural resources out of the Russian maritime Arctic to global markets. Recent annual numbers of ships making a complete Northeast Passage (ocean to ocean) range from a high of 45 ships in 2020 and a low of 14 in 2017.

The management of the NSR since a December 2018 federal law is split between two organizations: The Ministry of Transport adopts the rules and regulations for navigation on the NSR; and, Rosatom, the State Nuclear Company, manages the infrastructure development of the NSR including ports, navigation systems, icebreakers, accident response capacity, and safety systems. Rosatomflot manages the Russian Federation's nuclear icebreaker fleet, a key to providing escort of commercial ships in convoy along the NSR, and essential to achieving year-round marine access (and sovereign presence) to all regions of the Russian maritime Arctic. The federal fleet of icebreakers is used to support commerce including summer sealift to small cities and communities along the NSR, and to assist the Ministry of Defense in infrastructure development in the Russian North and the summer escort of naval ships across the NSR.

Changing Marine Access

The Arctic Ocean's sea ice cover has been undergoing profound changes for nearly five decades. Select characteristics such as sea ice extent have been monitored and documented by routine satellite coverage. The ice has been thinning, there has been extent reduction in all seasons (and in nearly all regions), and the area of multiyear ice (ice that has survived the melt season) has been dramatically reduced.[8] It is also plausible that the sea ice has become more mobile (as it thins) when responding to Arctic winds, another factor adding to the uncertainty of future polar ship navigation. This important environmental transformation holds obvious and key implications for Arctic ship navigation and marine commerce: Greater marine access is available in summer, as well as during spring and autumn months. Longer seasons of navigation are becoming the norm especially where the Arctic waters are ice-free or partially ice-covered. However, one of the most critical and practical factors for future marine commerce is that the Arctic Ocean is not ice-free year-round, but it is fully or partially ice-covered for more than half the year (6–8 months) throughout the century. Recent research indicates that the spring-winter-autumn sea ice cover will remain in a warmer world, but the areas of open water will continue to expand in the decades ahead.[9]

A seminal event will also likely occur on or before summer 2050 as indicated by global climate model simulations of Arctic sea ice: Old or multiyear ice will completely disappear in late summer. The Arctic Ocean will be entirely ice-free during this future summer day and no sea ice will survive into the next season. From this historic day *in* the future, the Arctic Ocean will be covered with only seasonal (first-year) sea ice and likely will become more navigable.

One of the questions that arises is how the global maritime industry might use the Arctic Ocean *seasonally* along coastal routes and even in the Central Arctic Ocean (CAO) for trans-Arctic voyages. For trans-polar voyages (across the CAO) in future winters, the challenges are significant. Voyages of 2,200 to 2,600 nautical miles would have to be safely and efficiently conducted with a continuous ice-cover of seasonal ice (an estimated 1.8 to 2.5 meters thick) with the entire operations in total or partial darkness.[10]

While technically possible using advanced (commercial) icebreaking ships, this trans-Arctic (winter) option holds too many uncertainties related to practical navigation issues and economic constraints. The more feasible and economically viable options for trans-Arctic navigation are across the NSR in summer and perhaps during summer in the CAO with bulk carriers and other specialized ships in niche (cargo) markets. It remains highly unlikely the global trade routes for large container ships will be altered by the opportunities afforded by greater Arctic marine access. The seasonality of such potential routes, the higher costs of polar class ships, the vagaries of Arctic weather (and sea ice), and other uncertainties (such as time-sensitive cargoes and average ship speeds) make such routine and regular voyages implausible.

Complexity, Economic Drivers, and Uncertainties

The Arctic Council's *Arctic Marine Shipping Assessment* (AMSA)[11] released in April 2009 is one of the more influential and successful studies the Council has conducted. It can be viewed in three ways: as a baseline assessment and snapshot of Arctic marine activity (using the AMSA's historic database of marine use in the Arctic marine environment); as a strategic guide for a host of Arctic and non-Arctic stakeholders and actors with a compendium of drivers of change and uncertainties in Arctic marine navigation; and as a *policy document* since the report and its recommendations were negotiated and consensus reached with approval by the eight Arctic ministers.

One of the most important contributions of AMSA was its scenarios-creation effort that helped reveal many of the driving forces and uncertainties that might shape the future of marine navigation and influence the levels of marine commerce in a future Arctic Ocean. The complexity of this theme became apparent early in the process when the AMSA team identified 120 factors or driving forces. The most important of the factors include: the importance of a stable legal and governance framework for the Arctic Ocean; global oil prices; rapid climate change (changes will be more disruptive sooner than anticipated); new natural resources discoveries (offshore and onshore); a major Arctic shipping disaster (a wildcard and potential "game changer"); limited windows of operation (the seasonality of operations and economic implications); the roles of transit fees along Arctic coastal routes; the engagement of the maritime insurance industry; the timing of a global (IMO) agreement on polar ship rules and standards; the emergence of new Arctic Ocean operators such as China, Korea, and Japan; global trade dynamics and patterns; the severity of climate change (on Arctic sea ice) and impacts on global weather; the potential escalation of Arctic maritime disputes; the safety of other global routes (Suez and Panama canals); and Arctic maritime enforcement.[12]

These select factors or uncertainties illustrate the complexities and key global connections that can affect future Arctic marine commerce. In the AMSA scenarios process, two factors forming the axes of a four-scenario matrix stood out as most plausible and relevant to Arctic maritime affairs: resources and trade (the level of demand for Arctic natural resources and international trade); and governance (the degree of stability of rules and standards for ships within the Arctic and internationally).[13] These factors anchored the creation of a set of scenarios that highlighted the connections of marine commerce to the global economy. Notably, climate change and Arctic sea ice retreat were influential factors in each of the scenarios as they allowed for greater marine access throughout the Arctic Ocean and longer seasons of marine navigation and commercial activity. However, the primary message from the AMSA scenarios work is that economic factors—Arctic natural resource development, global commodities markets, and connections to global markets—are the fundamental drivers of Arctic marine commerce, most certainly for large, oceangoing commercial ships. In viewing the levels of commercial marine traffic and types of ships observed in the Arctic Ocean during 2019 and 2020, the AMSA scenarios outcomes have proven accurate. The dominance of destinational voyages by commercial ships, in contrast to trans-Arctic voyages, relates directly to the economic realities of the global shipping enterprise, and the pace and economic viability of Arctic natural resource development.

Governance of Marine Operations and Shipping

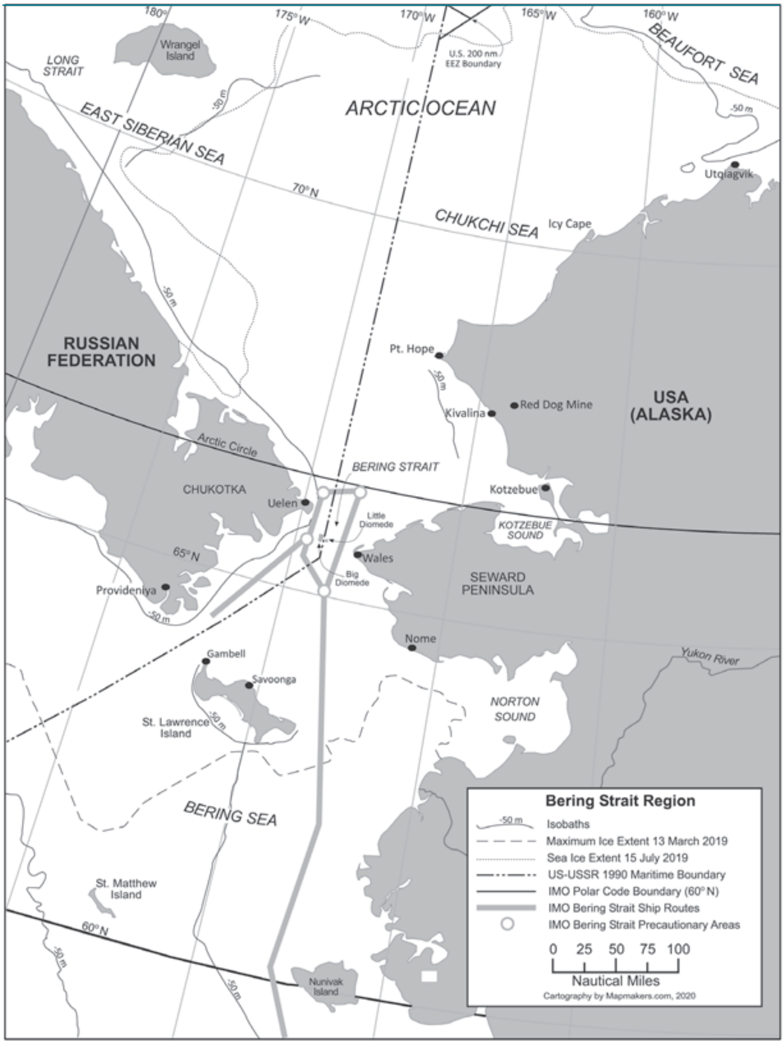
The primary governance of Arctic marine operations and commercial shipping is the legal framework of the United Nations Convention on the Law of the Sea (UNCLOS).[14] UNCLOS sets out the regulation of shipping and marine operations using maritime zones of jurisdiction. The five Arctic Ocean coastal states and Iceland have established their set of maritime zones including: internal waters; a 12-nautical mile territorial sea; a 24-nautical mile contiguous zone; and a 200-nautical mile Exclusive Economic Zone (EEZ).[15] Every coastal state has full sovereign rights and control in its internal waters; the territorial sea (usually out from a baseline or mean low-water mark) is the sovereign territory of the coastal state, but foreign ships (civilian and military) are granted the right of innocent passage through these waters and transit passage through straits used for international navigation. Under UNCLOS Article 19, foreign ships making an innocent passage must not: disrupt the security of the coastal state, fish, conduct military operations, or pollute the waters during their continuous and expeditious passage. The rights of innocent and transit passage are fundamental to marine commerce and international trade.[16]

Of special significance to Arctic marine navigation, UNCLOS Article 234 allows the Arctic coastal states to adopt and enforce non-discriminatory pollution, prevention, and control laws within the waters of their respective EEZs (waters that are ice-covered most of the year). Canada and Russia have used this provision to create special rules and regulations (shipping regulatory regimes).[17] Both nations have also closed off select Arctic waters and straits to international shipping by declaring internal waters with complete sovereign control, actions that remain highly controversial in the global maritime community. Less controversial has been the approval at the International Maritime Organization of the mandatory *International Code for Ships Operating in Polar Waters* (the Polar Code) which came fully into force on July 1, 2018, following more than two decades of development.[18] The Polar Code is a set of amendments to existing IMO conventions that includes: regulations for ship construction and safety equipment; standards for mariner training and experience; and regulations on pollution discharges. Commercial ships operating in the Arctic Ocean must have onboard a Polar Ship Certificate (normally issued by the flag state) and a Polar Water Operational Manual (tailored to a specific ship's capabilities).[19]

The Polar Code also includes new classes of polar ships based on operational capability in sea ice: the highest PC 1 (capable of year-round operation in ice) to the lowest PC 7 (capable of summer/autumn operations in first-year sea ice). The Polar Code has special relevance to future ships on trans-Arctic (international) voyages. All must have a Polar Certificate onboard under the Code, and all will be sailing in "polar waters," having entered the Code's boundaries in the Bering Sea or across the North Atlantic. The mandatory Polar Code represents an historic advance of enhanced marine safety and environmental protection measures in polar waters and a framework for future regulations. The economic implications of the Code for Arctic marine commerce add to the complexity of factors influencing the viability of marine navigation in such a difficult and sometimes unforgiving environment.

Figure 2's map of the Bering Strait region indicates that most of the area is a shallow continental shelf with a depth of 50 meters or less. The narrowest part of this international strait between Chukotka and Seward peninsulas is 46 nautical miles (86 kilometers) and the U.S.–USSR 1990 Maritime Boundary essentially bisects the strait running between Big and Little Diomede islands. The region is normally ice-covered for five months. The map shows the maximum extent of Arctic sea ice stretching south of St. Lawrence Island on March 13, 2019. By July 15, 2019, the ice edge had retreated north beyond most of the Chukchi Sea. Commercial traffic on the U.S. side of the Bering Strait is mainly composed of tugs and barges that operate only in a summer (ice-free) sealift to support coastal communities and North Slope oil and gas development. This coastal traffic follows the ice edge retreat during the spring melt back.

FIGURE 2: Map of the Bering Strait Region Indicating the IMO Voluntary Marine Routes and Boundary of the IMO Polar Code at 60N



Source: Author and Cartography by Mapmakers.com 2000.

During the summer ice-free months, large bulk carriers anchor off the coastal community of Kivalina to service the Red Dog Mine and carry high-grade zinc ore to global markets in the Pacific. Since these large ships, all on international voyages, are sailing north of 60 degrees north, the new IMO Polar Code boundary, they must adhere to the Code's safety, marine pollution, and mariner competency requirements as well as carry a Polar Ship Certificate and Polar Water Operational Manual. On the Russian coast of the Bering Strait, large commercial ships sailing north will enter the Polar Code boundary at 60 degrees north and once they have crossed the Arctic Circle, must also follow the rules and regulations of the Northern Sea Route. Also indicated on Figure 2 is the new ship routing scheme approved by the IMO on December 1, 2018, after a joint submission by Russia and the United States. There are six, two-way routes each 4 nautical miles wide with 6 precautionary areas; the routes are *voluntary* for vessels 400 gross tonnage and above.[20] The IMO Polar Code boundary and ship routing scheme in the Bering Strait provides new governance measures to enhance marine safety and environmental protection in one of the most environmentally sensitive regions of the global oceans.

AMSA Recommendations and Implementation

The most influential component within AMSA is the list of 17 recommendations that the Arctic states negotiated and the Arctic Ministers approved.[21] Each of the recommendations relate directly to marine commerce. Together they represent a policy framework for the eight Arctic states to pursue timely initiatives regarding marine safety and environmental protection. The recommendations focus on three inter-related themes: (A) *Enhancing Arctic Marine Safety*; (B) *Protecting Arctic People and the Environment*; and (C) *Building the Arctic Marine Infrastructure*. Since AMSA's release in April 2009, substantial progress has been made in enhancing marine safety with broad international cooperation at the IMO and among the Arctic states. The Arctic states have worked together successfully to place use of the emerging Arctic Ocean on the IMO's agenda, but also within bodies such as the International Hydrographic Organization (IHO) and the World Meteorological Organization (WMO). AMSA called for mandatory Arctic shipping rules and regulations and the IMO Polar Code was the historic outcome. AMSA identified the need for an Arctic search and rescue (SAR) instrument and such a binding agreement was signed by the eight Arctic ministers in Nuuk, Greenland, on May 12, 2011.[22] A key element of the agreement was the division of the Arctic space into SAR regions. Each of the eight Arctic states has responsibility for response coordination in their designated region.

Under theme (B), the Arctic states have individually made progress at engaging with Arctic communities and developing mechanisms to link with the shipping industry to plan new marine facilities (to mitigate impacts and increase benefits). Arctic states have conducted limited surveys of Indigenous marine use and identified gaps as part of their assessment of the impacts of Arctic shipping and marine operations. The AMSA team envisioned a more holistic approach, a circumpolar and integrated survey, but this critical database has yet to be fully achieved. However, the Arctic states under three of its working groups (Arctic Monitoring and Assessment Programme, Conservation of Arctic Flora and Fauna, and Sustainable Development Working Group) produced a comprehensive report and atlas in 2013 titled *Identification of Arctic marine areas of heightened ecological and cultural significance*.[23] This baseline assessment indicates marine areas that would be sensitive and vulnerable to marine operations (examples include oil spills, industrial/ship noise, and ship strikes) and can be used to establish future, internationally-designated areas for protection. Progress on designated Arctic marine areas (such as marine-protected areas and IMO Particularly Sensitive Sea Areas) has been slow due to the Arctic states' reluctance to address protected areas outside their EEZs or those that would straddle boundaries between coastal states. Arctic Council experts have engaged with the International Whaling Commission in an Anchorage, Alaska workshop in March 2014 to address the impacts of Arctic marine operations on cetaceans, a critical issue for Arctic Indigenous communities and cultures. Recommendations in theme (B) involving measures of protection from invasive species and the reduction of commercial ship emissions are being addressed at IMO in evolving global conventions and agreements on ballast water and greenhouse gas emissions. Arctic-specific regional agreements for these environmental challenges have not yet been addressed.

The AMSA recommendations in theme (C) cover a broad spectrum of infrastructure: ports, communication systems, ice navigation training, icebreakers, ice information (ice centers), marine traffic systems, environmental response capacity, and importantly, hydrographic, meteorological, and oceanographic information. The AMSA team understood these recommendations would perhaps be the most challenging to implement. To close the huge Arctic infrastructure deficit would require effective long-term planning and large investments from public and private sources and new public-private partnerships. Arctic marine traffic information has improved greatly since AMSA with the development of advanced satellite and land-based Automatic Identification System (AIS) tracking systems. Circumpolar environmental response has improved with the signing of a second Arctic state binding agreement in May 2013, the *Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic*.[24] In addition, Russia, Canada, and the United States have increased hydrographic surveying in their Arctic EEZs, specifically focusing on "Arctic shipping corridors" through their coastal waters, and the IHO in 2010 established the Arctic Regional Hydrographic Commission to focus on surveying and mapping the extensive uncharted waters of the Arctic Ocean. WMO, together with IHO and IMO, fully established in June 2011 five new WMO METAREAs (maritime geographic areas for the distribution of meteorological information) and IMO NAVAREAs (maritime geographic areas for navigation information) with Canada, Russia, and Norway dividing leadership and responsibility for marine services in the regions. Much more investment in Arctic marine infrastructure is required, but AMSA raised the visibility of this significant and integral component of marine safety and environmental protection.

Alaska and Arctic Marine Infrastructure

The lack of marine infrastructure in the U.S. maritime Arctic is a significant national gap that presents serious economic, social, political, environmental, and military security implications for the United States moving forward as a 21st century Arctic state.[25] Not only is this infrastructure deficit a critical need that limits America's sea power, it also is a significant constraint on marine commerce and the overall economic development of the Alaskan Arctic. Such a deficit constrains efforts to provide a robust marine safety and environmental protection response network, particularly in view of the potential for increasing Arctic marine operations and future marine incidents.

Many federal infrastructure investments are needed to meet a host of maritime requirements: hydrography and charting (and a long-term strategy by NOAA's National Ocean Survey to survey and chart the U.S. Arctic Exclusive Economic Zone); building a strategic, deep water Arctic port in Nome, Alaska; enhancing military and civilian communications systems (to include submarine fiber-optic cables connecting coastal communities, vital defense facilities and industrial sites); observing systems to improve ice and weather forecasting as well as initiatives to enhance the entire operational marine and terrestrial observation network in Alaska; building a viable U.S. Coast Guard Polar Security Cutter (polar icebreaker) fleet; improving the satellite and shore-based monitoring and surveillance system to improve domain awareness; and, expanding Arctic search, rescue, and environmental response capacities. Longer-term federal, private, and public-private partnership investments are required to facilitate economic development focusing on the linkages of Alaska's abundant natural resources to global markets. All these developments require marine transportation systems (such as export ports in the U.S. maritime Arctic) and intermodal connections. An example would be a railway corridor linking a new deep water port in Nome to Fairbanks, Alaska, which would connect to the existing Alaska Railroad system running south to Anchorage (and Alaska's primary seaport).[26]

The nearly complete lack of infrastructure in the U.S. maritime Arctic remains a critical vulnerability and strategic shortcoming for Alaska and the nation. The private sector's episodic investments in infrastructure, such as during Shell's offshore exploratory drilling for oil in Chukchi Sea between 2008 and 2015, have not addressed the fundamental gaps in this Arctic frontier region. Initial federal (baseline) infrastructure investments should be guided by an interagency Arctic strategy and an integrated management plan. However, longer-term funding must be coupled with private investments and public-private partnership initiatives.

The Path Forward

Marine access in the Arctic Ocean will likely continue to increase in all seasons with the relentless retreat of sea ice. However, the Arctic Ocean will remain fully or partially ice-covered in autumn, winter, and spring, presenting a practical barrier to routine and year-round, trans-Arctic voyaging. How current global trade routes, primarily those used for container shipping, might be influenced by longer seasons of navigation in Arctic waters remains highly uncertain. It is plausible that summer, trans-Arctic voyaging may be achieved in niche markets and the traffic could become *seasonal supplements* to more southern routes such as those through the Suez Canal. Nevertheless, the focus of Arctic marine commerce will likely continue to be on destinational shipping in the coming decades that will forge greater links between Arctic natural resources and global markets.

Under this scenario, Arctic marine commerce may or may not flourish due to the fluctuations and uncertainties in global commodities prices and the overall pace of Arctic natural resource development. The Russian maritime Arctic, offshore Norway, Greenland, the Canadian Arctic, and coastal Alaska are all tied in many ways to this plausible scenario with its many uncertainties. However, somehow restructuring global trade routes through Arctic waters on a large scale appears to be neither economically nor operationally feasible. The seasonal nature of Arctic marine navigation for large container ships is a crucial consideration and major constraint.

Governance of the Arctic Ocean, with UNCLOS as the legal framework, should continue to evolve with further amendments to and enforcement of the IMO Polar Code. An amendment dealing with a ban on heavy fuel oil use to power ships in the Arctic has been approved at IMO. Other potential issues to be pursued are the inclusion of fishing vessels under the IMO Polar Code and creation of an Arctic Emissions Control Area under the IMO MARPOL Convention (*Interntaional Convention for the Prevention of Pollution from Ships*) similar to other marine areas around the globe. The Arctic Council and its expert working group, Protection of the Arctic Marine Environment, have embraced the concept of ecosystems-based management and the expanded use of marine protected areas. Both measures would have significant influence on Arctic marine commerce. Future enforcement of the IMO Polar Code can be enhanced with a Port State Control Agreement negotiated among the Arctic states, an agreement that should include the timely transfer of marine traffic information between coastal states in anticipation of ships moving into their respective Arctic marine areas, or Exclusive Economic Zones. Expanded joint enforcement of the Polar Code with such cooperation can potentially improve marine safety and environmental in trans-boundary areas.

Arctic marine commerce is here to stay at levels never previously observed in the history of the Arctic Ocean. Marine use will inexorably increase in all commercial sectors, including perhaps fishing (in select but not all) EEZs of the Arctic Ocean coastal states. Uniquely, marine commerce has driven the need for enhanced Arctic state cooperation and broad cooperation on maritime issues is expected to continue. The Arctic Council's AMSA is a primary example of how ministers of the eight Arctic states reached consensus on a framework strategy to protect Arctic people and the marine environment. Five binding agreements related to Arctic marine commerce have been promulgated since 2011, including Arctic state agreements on Arctic search and rescue, oil spill response, and research; the IMO and all the global maritime nations' agreement on a binding code of regulations (the Polar Code) for ships operating in Arctic and Antarctic waters; and a Central Arctic Ocean Fisheries Agreement ratified by six Arctic states, select non-Arctic states, and the European Union. While key legal disagreements regarding navigation in certain Arctic straits and coastal waters persist, unprecedented international cooperation and dialogue has addressed the environmental security and safety challenges of greater marine use. It is highly plausible marine commerce and transportation issues will *not* be the cause of discord or even conflict in the Arctic, but rather avenues to promote regional stability and closer international collaboration throughout the 21st century.

Recommendations for the U.S. Congress and Administration

- **Ratify UNCLOS.** The U.S. Senate must ratify UNCLOS for fundamental commercial and economic security reasons that match our national interests. Ratification will allow the United States to secure its sovereign rights to the extended continental shelf off northwest Alaska into the Arctic Ocean. Senate ratification will reaffirm the importance of securing sea lines of communication and freedom of navigation. Both are vital to international commerce and trade.
- **Close the marine infrastructure gap.** The lack of an Arctic port and key marine infrastructure are critical gaps in our nation's military, economic, and environmental security in the region. Increased federal funding is required for a range of basic infrastructure: hydrography and charting; an Arctic port in Nome, Alaska; a modern communications network; aids to navigation; domain awareness; enhanced electronic navigation; an environmental observation network; search and rescue capacity; and environmental response capacity. All of these investments are directly related to facilitating safe and efficient marine commerce in the U.S. maritime Arctic.

- **Develop new polar icebreaking capacity.** New Polar Security Cutters (PSCs) are essential for the United States to remain a leading polar nation. These icebreakers are instruments of national policy and the visible sovereign presence of the United States in polar waters. Continued funding of the U.S. Coast Guard's PSC acquisition program (focused on a fleet of three heavy/large and three medium/shallower draft cutters) remains a national priority. They provide support to a broad range of missions in polar waters: law enforcement; naval operations; search and rescue; environmental response, marine safety; research; and icebreaking operations. The PSCs represent a critical gap in America's sea power.
- **Implement and enforce the International Maritime Organization Polar Code.** The U.S. Coast Guard has the federal responsibility to continue implementation and enforcement of the IMO Polar Code for commercial ships operating in Arctic and Antarctic waters. Such action by the Coast Guard is especially true for the Bering Strait region, for bulk carriers sailing to Kivilina (port facility for the Red Dog Mine), and for the entire coastline of Arctic Alaska north of 60 degrees north). The Coast Guard must continue a leadership role at IMO in London addressing all aspects of improving and refining the Polar Code.
- **Share Arctic marine traffic information.** The Arctic Council and the Arctic Coast Guard Forum should initiate development among the Arctic states a mechanism for sharing Arctic marine traffic data in real time. Both bodies should institute coordinated Port State Control measures to tighten enforcement of the IMO Polar Code. The U.S. Coast Guard should play a lead role in orchestrating these Arctic marine safety measures to enhance protection of our Arctic coastal communities and the marine environment.

ABOUT THE AUTHOR

Dr. Lawson W. Brigham is a Global Fellow in the Wilson Center's Polar Institute. He is a researcher at the University of Alaska Fairbanks (UAF) and a Fellow at the U.S. Coast Guard Academy's Center for Arctic Study & Policy. Captain Brigham was a career Coast Guard officer and commanded four cutters including the polar icebreaker *Polar Sea* on Arctic and Antarctic expeditions. He has been a faculty member at the Coast Guard Academy, Naval Postgraduate School, and UAF, and a Marine Policy Fellow at Woods Hole Oceanographic Institution. During 2004-2009 he was chair of the Arctic Council's *Arctic Marine Shipping Assessment* and Vice Chair of the Council's Protection of the Arctic Marine Environment Working Group.

Dr. Brigham has served on the U.S. Delegations to the Arctic Council and International Maritime Organization (for the IMO Polar Code) and has testified on Arctic issues before both Senate and House committees of the U.S. Congress. He is graduate of the Coast Guard Academy and the Naval War College, and holds graduate degrees from Rensselaer Polytechnic Institute (MS) and Cambridge University (MPhil and PhD). His publications and research interests have focused on the Russian maritime Arctic, Arctic marine safety & environmental protection, Arctic climate change, marine transportation, and polar geopolitics. A current member of the National Academies Polar Research Board, he is also an elected member of the Council on Foreign Affairs and the Norwegian Scientific Academy for Polar Research. A central peak in the Gonville & Caius Range, Victoria Land, Antarctica was named Mount Brigham in January 2008 by the U.S. Board of Geographic Names.

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February 2017. Arkhangelsk, Russia. Tanker Magellan operating in ice on the Northern Dvina River in the Arkhangelsk Region. *Editorial credit*: Sergey Yakovlev / Shutterstock.com.

Image source: Arctic city of Tromso with Sommaroy Bridge is a cantilever bridge connecting the islands of Kvaloya and Sommaroy - Tromso, Norway. By muratart / Shutterstock.com

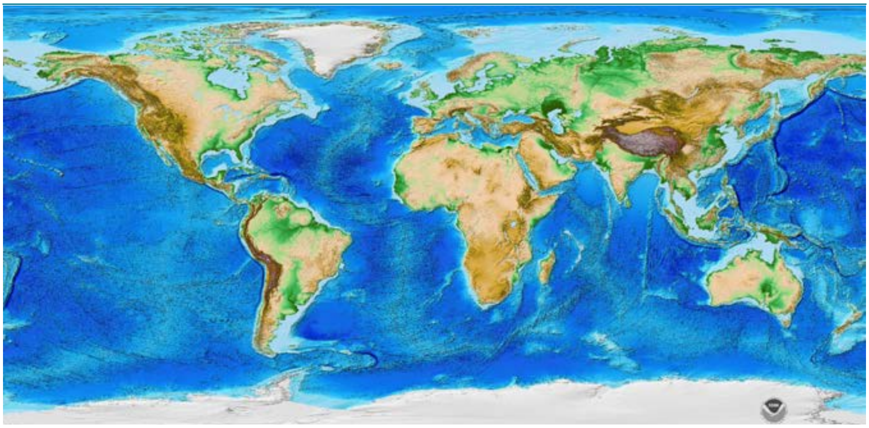
By Dr. Alyson Azzara

Navigating the Future of Connectivity in the Arctic

Connectivity means different things to different people. The Oxford Dictionary defines it as "the state or extent of being connected or interconnected." The term can refer to anything from the typical computer-based application, to a broad portfolio of electronics, to a dropped phone call, to the fiber optic cables that connect the world's banks and economies. But, perhaps for some, it refers to the ships that sail around the globe exporting and importing everything from bananas to sneakers to cars to tons of oil, gas, and critical minerals. Maybe it's the whale that swam thousands of miles to take part in Nalukataq or the king crab that crawled across the Pacific Ocean only to be caught, processed, packaged, and shipped across two more.[1] For others, it's the research vessel frozen into the ice that brings scientists from around the world together for a year, or the Coast Guard flying in from a thousand miles away to airlift a sick patient to the hospital.[2]

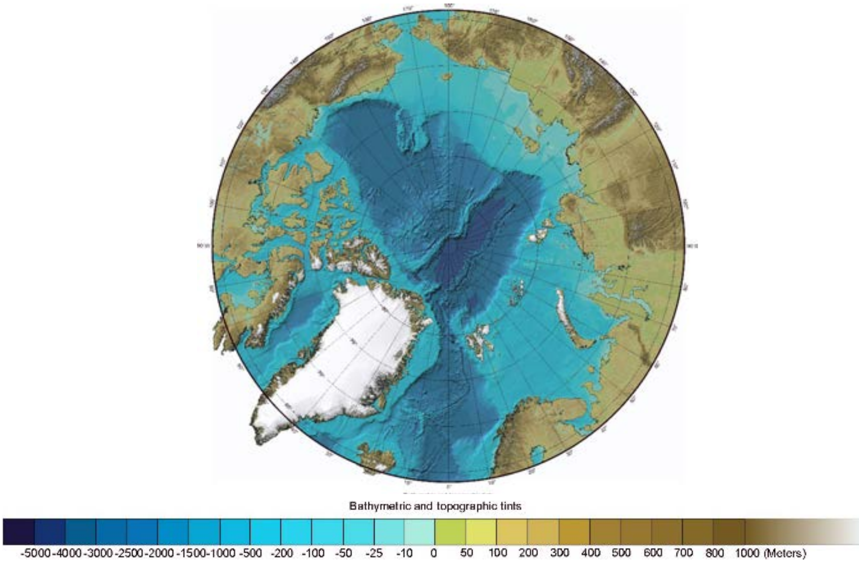
It is often hard to visualize this Arctic system as so closely linked with the world, cut in half and laid flat as it is on a traditional map (Figure 1). From that vantage point the Arctic is vast and disconnected. Russia is on one side and Alaska all the way on the other. In reality, Alaska and Russia are only 53 miles apart across the Bering Strait. While Canada and Russia appear fully separated on a world map, the journey can be made over the ice from Russia to Canada (if one is brave enough to try it)[3]; the two countries are closer than Los Angeles and Boston. In fact, airplanes cross the Arctic Circle every day to connect North America to Asia and Europe because the distances are shorter. While encompassing the entire top of the globe, the Arctic is more connected than most imagine (Figure 2).

FIGURE 1: Global relief model of Earth's surface



Note: ETOPO1 is a 1 arc-minute global relief model of Earth's surface that integrates land topography and ocean bathymetry. This model is used to calculate the volumes of the world's oceans and to derive a hypsographic curve of Earth's surface. *Source*: NOAA.[4]

FIGURE 2: International Bathymetric Chart of the Arctic Ocean (IBCAO)



Current Map of Arctic Ocean bathymetry *Source*: NOAA.[5]

This chapter describes connectivity in four ways: environmental, social, economic, and geopolitical. These are often considered separate sectors requiring unique and differentiated solutions. However, this chapter poses the argument that, instead of confining connectivity within any one sector, the recognition of interconnectedness across sectors will spur the next round of successful discussions, policy, and program development in the Arctic region. Therefore, while this chapter will introduce connectivity in several ways, the discussion will flow between and among them.

Environment

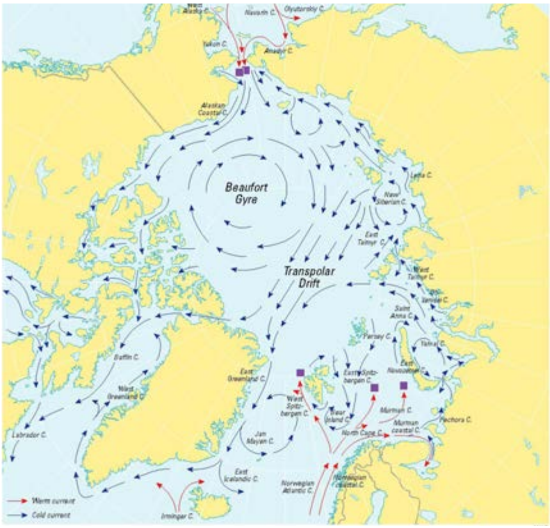
As discussed elsewhere in this monograph, global climate is changing rapidly; more so in the Arctic than anywhere else. Although this statement creates a first order divide—the Arctic vs. everywhere else—the Arctic is not confined within the glass of a snow globe. Since the planet's climate systems are interconnected, what happens in the Arctic does not stay in the Arctic.

FIGURE 3: Map of global ocean circulation

Note: Thermohaline circulation drives a global-scale system of currents called the "global conveyor belt." The blue arrows indicate the path of deep, cold, dense water currents. The red arrows indicate the path of warmer, less dense surface waters. It is estimated that it can take 1,000 years for a "parcel" of water to complete the journey along the global conveyor belt. *Source:* NOAA.[1]

1 NOAA, "The Global Conveyor Belt," <https://oceanservice.noaa.gov/education/tutorial_currents/05conveyor2.html>.

FIGURE 4: Arctic Ocean circulation



Note: The wind-driven Arctic ice circulation pattern has two primary components. First, the Beaufort Gyre is a clockwise circulation (looking from above the North Pole) in the Beaufort Sea, north of Alaska. A second component is the Transpolar Drift Stream, where ice moves from the Siberian coast of Russia across the Arctic basin, exiting into the North Atlantic off the east coast of Greenland. *Source:* National Snow and Ice Data Center[2] and Arctic Monitoring and Assessment Programme (AMAP), (1998).

Take the ocean for example: Ocean currents connect the Arctic seas to the world's oceans, acting as the beginning and the end of global ocean circulation (Figure 3). Water enters the Arctic and is reborn through a process of freezing and sinking, where it is exported again along the ocean bottom. This circulation redistributes ice and cold water; spurs upwelling, down-welling, and turnover from freeze and thaw cycles; brings in nutrients supporting algal blooms of phytoplankton; and nourishes the plethora of marine mammals, birds, and fish that migrate to and through the Arctic annually. The riverine systems flowing north supply sediment and additional nutrients into the system, connecting the oceans, seas, rivers, and coasts of the Arctic states, their land, and their people.

2 National Snow & Ice Data Center, "Dynamics: Circulation," Updated April 3, 2020, https://nsidc.org/cryosphere/seaice/processes/circulation.html.

These large ocean processes connect people who hunt, prepare, and share food and culture. They connect communities through sustainable local fishing, hunting, and trapping; as well as the global economy through billion-dollar fisheries, cruise, and eco-tourism industries. For example, Alaska fisheries generated $5.6 billion in economic activity in the 2017–2018 season in addition to the state's multimillion-dollar charter fishing industry.[6] In 2015, the landed value of the Norwegian fisheries totaled $2.2 billion.[7, 9] When it comes to tourism, an Arctic cruise can cost anywhere from $2,000 per person to $42,000 with general pricing between $7,000 and $20,000.[8] Though often discussed as an entity separate from society, the environment supports global connectivity through social and economic resources and links international commerce, policy, and diplomacy.

Social

Social connectivity in the Arctic underpins the region's culture and way of life. Just as environmental connectivity brings currents, nutrients, marine mammals, and fish, social connectivity sustains subsistence ways of life and maintains ancient cultural traditions. In the age of social media, connectivity extends further and faster than ever before. The ability to connect, call, upload, download, FaceTime, stream live, or Zoom changes the needs for and definition of what it means to be connected. While much of the globe is equipped for this new digital age, a large portion of the Arctic is not. While the average U.S. speed is 59 megabits per second (mbps), average Arctic speeds are only 15 mbps, relatively good speeds are around 25 mbps, and some communities lack wired internet connection all together.[9] This disparity in service creates a literal and figurative disconnect from and among the people of the Arctic region. However, if a research vessel frozen in the ice can be connected at 100 mbps, it stands to reason that the lack of connectivity in other parts of the Arctic is not because of a lack of technology or capacity.[10,11]

Several companies have expressed interest in expanding broadband and fixed internet connectivity to the High North. Increased accessibility would certainly improve overall connectivity, but how reliable these services will be remains to be seen. Even now, communities in the Arctic with connectivity experience unanticipated outages that can last for significant periods of time.[11] Generally, internet is available through a single provider. This creates problems both with redundancy and with open market competition. If there is only one company, they compete against themselves for services and costs. When the service experiences challenges, there is little recourse and likely no secondary option or back up accessible to the community. This is true both for existing service providers and for those proposing enhanced service and infrastructure that fail to follow through for a variety of reasons.[12]

The impacts of slow to no connectivity have far-reaching implications beyond streaming entertainment services. Businesses, education, and health services are all affected by accessibility and reliability of communications connectivity. Oftentimes, discussions of energy or shipping sectors' needs eclipse public discourse around communities' basic needs to make reliable and affordable long distance calls, for instance. Yet these industrial operations rely on the assumption that enabling infrastructure, like phone and internet, will be available when and where it is needed. An overall lack of investment in basic services hinders the region, partly because discussions of infrastructure and development are separated into sectors. When our approach dissects the system, we overlook the overall, inherent social network and required connectedness among and between people, businesses, and services.

Economic

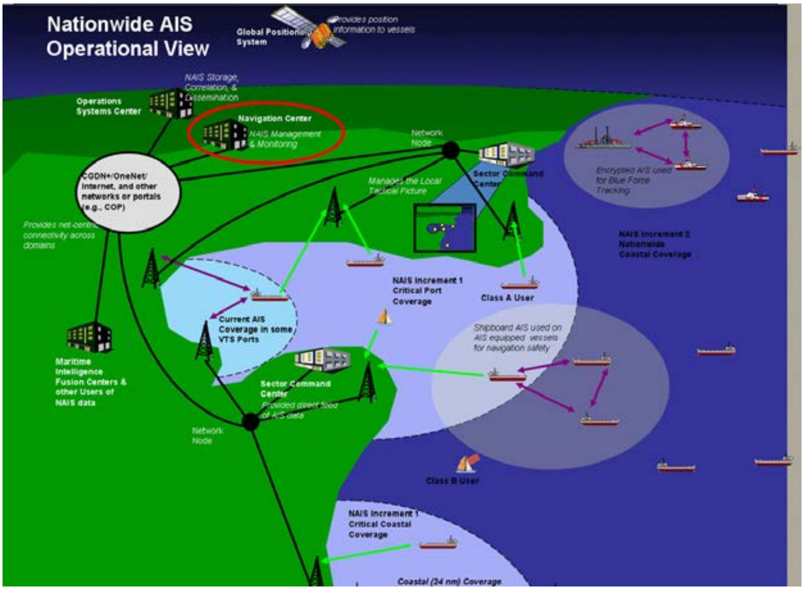
Economic connectivity is at once easier and harder to envision. Terms like the "global economy," "global markets," and "international trade" encompass the concept that the economy expands beyond a single location or individual business. When discussing development, the conversation often focuses on a single sector, resource, or location: ports, energy, mines, internet, for example. But these activities do not occur in a vacuum. Rather, they require an intricate network of enabling infrastructure to be successful.

Arctic ports, for example, are a hot topic. In concept, a port is a pier connected to the shore from which goods can be exchanged: simple. But in fact, ports are complex entities requiring many economic sectors to work together. To successfully operate, ports both provide for and require services from the community and the global economy: Electricity, communications, water and sanitation, equipment for moving cargo, pipes and headers to provide fuel and water to vessels, human capacity and workforce, among others. Discussing the development of ports without understanding and incorporating all the facets of infrastructure segments the conversation in ways that make successful planning and operation nearly impossible. It also disrupts the conversations about both funding and revenue streams that are needed to invest in large-scale operations.

Economic connectivity includes the connections between potential funding streams and investors. While one company may express interest in investing in a particular sector, that venture may not be economically feasible nor realistically actionable without investment in the enabling sectors. Take a technology company interested in creating data centers: Without internet speed and stability coupled with affordable and reliable energy (power) to keep the system running, the development of this business venture is likely untenable. Arctic shipping is another example: The physical movement of a ship through the Arctic seems simple, but that vessel's transit depends on information exchanges and working interfaces between multiple communication platforms, in addition to support services, fuel availability, emergency support, and icebreaking services.

The automatic identification system (AIS) network is part of the connectivity shipping requires. The International Maritime Organization (IMO) requires vessels to carry AIS transponders onboard and transmit their location regularly.[13] Vessels must have access to and operate the AIS equipment. In turn, operation of the system requires coordination to emplace AIS receivers, either very high frequency (VHF) or satellite, to receive the AIS signal and further mechanisms to transmit the data from there to a receiving center.

FIGURE 5: Nationwide AIS Operational View



The Nationwide AIS Operational View. (NAIS) provides the Coast Guard with a comprehensive view of AIS-carrying maritime traffic in U.S. waters. *Source*: U.S. Coast Guard.[16]

This complex system is a microcosm of the larger system needed to support economic activity in the Arctic. Without reliable, enabling infrastructure, the risk associated with vessel operations in the Arctic may outweigh the benefits, stifling investment in commercial shipping in the region. Networking and investing across sectors may provide economic opportunities and benefits that single-sector investment would not.

Geopolitical

The Arctic is connected not just among the eight Arctic states, but among those states and actors that wish to have a say and a role in how the region develops. This is a double-edged sword—while the region is generally considered to be one of cooperation, increasing rhetoric surrounding discussions of power competition and risk are changing the political and security landscape. A region that was once considered vast and inaccessible is now not only increasingly accessible but increasingly accessed by a variety of parties, from researchers to tourists, to military and national security personnel.

Because the region is still emerging as a destination, movement and oversight are fluid. The ability to come and go, while difficult because of environmental conditions, is not as limited or controlled as it is in other areas where infrastructure exists to monitor and limit access, such as through sea port terminals or airports. The desire to access the region is increasing at a time when enhancing connectivity is possible—however, the lack of interconnected infrastructure poses a risk to the safety and security of communities.

Geopolitical rhetoric and competition among states and companies for control of assets, like natural resources, internet technology, or port development, further demonstrates the interconnectedness of commercial and political sectors in the Arctic. While discussing the region as one of cooperation, we must acknowledge the emerging competition and security concerns for fruitful dialogue. Failing to acknowledge these areas of competition will lead to unintended consequences.

Arctic Network Connectivity

This chapter thus far has discussed different interpretations of connectivity. It has also posed the argument that separate discussions do a disservice to the overall goal of regional connectivity across many scales. Instead, future discussions should highlight Arctic network connectivity as the next step in bringing together sectors to address existing and emergent issues in the region. This approach transcends any single sector; it holistically addresses how the system's components cooperate to provide a service greater than any one of its parts.

The analogy of an office is both familiar and applicable. An office system has multiple parts: employees, computers, printers, routers, remote servers, email systems, virus protection, vending machines, coffee makers, etc. These all act together in synchrony even though each component is employed, purchased, and possibly overseen by a different department or entity. Expanding that office network, say through purchasing new computers, generally requires detailed discussions about underlying systems to support them. Software updates are rolled out consecutively, providing time for the server and systems to check that the updates are working correctly and not creating gaps or vulnerabilities. If the new network uses more remote connections (like telework and virtual meetings) the server is upgraded to be able to handle the data sent through the network. It is a system of components that adapts and evolves to meet the needs of the users.

The Arctic, as a region, is poised for this kind of network evolution. Some Arctic states and corporations hold enough knowledge and expertise to successfully expand the capabilities of the region. The need for new services is so large that systems can be constructed that are specific to the needs of the region with the capability to evolve. However, businesses will not evolve if they cannot connect and communicate with their employees and customers. If there is no redundancy in service to ensure that businesses have basic functional services, there is no incentive to develop and no reason to invest. The region is rich with natural resources and business opportunities, but if there is no way to access them, develop them, and export them, there is no viable business plan.

How to invest and who should invest are other ongoing debates. Given the diverse and expansive (and expensive) needs of the Arctic, efforts to enhance connectivity will require multisector, multilateral, and multinational investment across public, private, and philanthropic entities. Expanding the concept of connectivity beyond communications and applying it to the broader social and economic sectors enables a more holistic approach to investment, a wider interpretation of benefits, and possibly a larger financial return.

Multiple parties and actors need to be engaged to fund major development projects. The Delong Mountain Transportation System (DMTS) is a prime example of the power of multiple stakeholders and innovative financing to connect resources to markets and enhance regional business connectivity. This system opened to support the development of the Red Dog Mine in northwest Alaska, one of the world's largest producing zinc mines. The DMTS provides the necessary infrastructure for the transportation of the ore from the mine site to the ore export barges at the port and the required investment and coordination across sectors and actors including government, Alaska Native corporations, and the private sector.[17] This cross-coordination that connected the interest and responsibilities of investors, land owners, and government agencies resulted in a successful business collaboration and a model that is used in Alaska to fund private infrastructure initiatives through the Alaska Infrastructure Development and Export Authority.

Investment is a daunting task. There are many needs including the need to categorize and prioritize projects. While federal and state governments are often the most visible sources of funding for projects, they are not the only funding and coordination solution. Moreover, government funding may not always be the best solution when hamstrung by politics, funding and election cycles, and partisan motivations. Geopolitical priorities, too, may thwart otherwise beneficial and positive partnerships and initiatives. By identifying multisector projects that can build a network of services, it may be possible to attract funding and financing from a variety of players who see future benefit and increased returns for their investment.

The Path Forward

Connectivity is a complex issue that spans many sectors and can be defined in different ways. One of the reasons the Arctic is generally discussed by sector is because the requirement to not only envision but plan for the "big picture" can be overwhelming. There are a lot of needs across an expansive region. To narrow the scope and provide a starting point, three sectors emphasize the need for connectivity and provide opportunities to build a system that can evolve with the development of the region: communication, transportation, and energy. Not only do all other sectors depend on these entities in some capacity, but they are all dependent upon each other in one way or another. They are sectors that lend themselves to cooperative development and finance where the benefits extend beyond individual communities or specific businesses. They would also provide enabling infrastructure for regional growth and development in other sectors. For these sectors, the return on investment through networked development could be high enough to entice investors to explore innovative options and arrangements.

These same services underpinning economic development in the region intimately link to the availability of education services from grade school to college. Additionally, they would significantly affect accessibility to health services like telemedicine as well as other community requirements like affordable housing and adequate water and sanitation services. The development of cornerstone infrastructure offers the opportunity for connected services and infrastructure to assist in the evolution of the region to better serve its people as well as its businesses. As such, we need to overcome the division of these discussions into silos and instead elevate the conversation to one that embraces connectivity.

The following recommendations are offered to to advance future conversation and prompt new dialogue:

- **Continue to expand the conversation around connectivity** to facilitate cross-sectoral dialogue and problem-solving.
- **Explore multisector approaches to fill in gaps** in connectivity that yield multilevel benefits, from community to corporations.
- **Identify specific needs and gaps** that, when filled, provide enabling infrastructure with broad reaching benefits.
- **Identify multisector and multinational partnership opportunities** to tackle regional issues including financing and funding.

DISCLAIMER: Any references to non-Federal entities herein are for illustrative and educational purposes only and should not be construed as an endorsement of, or preference for, any product, service, or enterprise by the Maritime Administration, U.S. Department of Transportation, or U.S. Government.

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Dr. Azzara holds a Ph.D. in Marine Biology from Texas A&M University at Galveston and a Master's of Science in Oceanography from Texas A&M University, with research focused on the interaction between vessel activity, anthropogenic noise, and marine mammal communication in the Gulf of Mexico.

Telecommunication tower on the slope of a snowy mountain. Winter arctic landscape. View of the mountain top and the metal tower with antennas. Communication in the far north in the polar region. *Source*: By Andrei Stepanov / Shutterstock.com

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COMMUNITIES

Image source: Greenland Nuuk Fjord.
By RavenEyePhoto / Shutterstock.com

By Dr. Gwen Healey Akearok

Navigating the Future of Communities in the Arctic

INTRODUCTION

Kinauvit? Namimiutauvit? Who are you? Where are you from?

"To know who I am in the world as a person and as a researcher, for some audiences requires a statement of race, class, gender, ethnicity, dominant belief systems, and academic theoretical leanings. On the Inuk side, it requires – most importantly – a knowledge of who my parents are, who my relations are, how many children and grandchildren I have, if any, and what lands I am connected to and associated with."

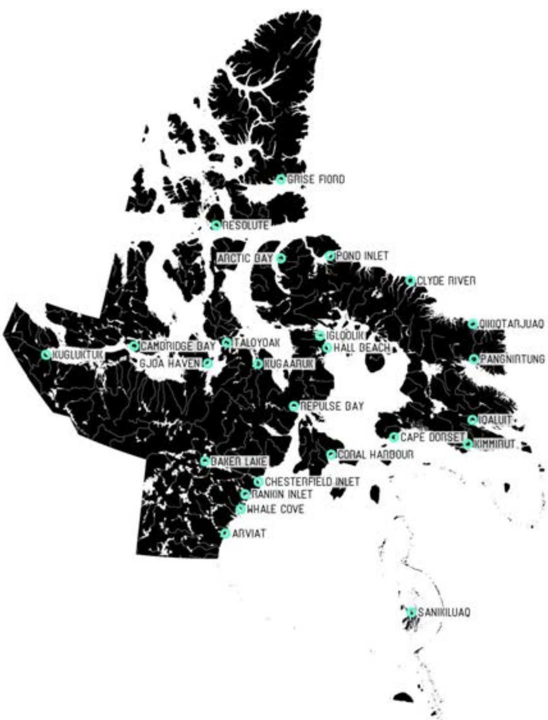
–Janet Tamalik McGrath (1)

Our Arctic communities are beautiful. Beautiful in their similarities and diversity. These communities are built on ancient stories and grounded in relationships with the land and water, while simultaneously playing an active role in today's interconnected world. Storytelling is an important part of life and learning, and this is particularly true in communities across Canada's North (2-10) and, indeed, throughout the Arctic. Our stories are rich with history, lessons, information, philosophy, language, and spirituality (11-19). To fully understand the meaning and significance of these stories, the reader should understand the origin of these stories.

For this reason, I will first introduce myself and my community to help the reader derive more meaning from this chapter. What Tamalik described in the introductory quote is true: When we greet each other in the North, we establish a connection based on the community we are from and to whom we are related. Sometimes we find that relationships already exist between us; long-standing family ties, relationship from outside of the region, or through childhood friendships. In other cases, we form new relationships. These relationships are the beginning of our interaction and discovering the connecting points from which we move forward together. So, in keeping with the custom to which I am most familiar, I will introduce myself this way.

My name is Gwen Katheryn Healey Akearok. I was born and raised in *Iqaluit*, Nunavut.

FIGURE 1: Map of Nunavut



Credit: Lateral Office, 2014

I am the eldest of two girls. My father (now retired) was the music teacher at the local high school in Iqaluit (formerly known as Frobisher Bay, Northwest Territories). My mother (also retired) ran the laboratory at the Baffin Regional Hospital for over two decades. My spouse is originally from *Sanirajaq* (Sah-nee-rah-jaak) (formerly Hall Beach, Nunavut) and later moved to Iqaluit to attend school. We have two young daughters who carry the names (and traits) of family members from my spouse's home community. When I meet new people in other communities, they will often know my parents and will tell me stories about them. They speak of how my father taught them, or how they met my mother at the hospital while they were escorting a sick relative. And vice versa, I often know their children or their grandparents, or grew up with one of their family members. Because of the extensive family and community relationships that exist in our region, many families in Nunavut are connected and/or related in some way. I share this as an insight into not only the beauty of our communities, but also the interconnectedness of my home community and communities throughout the circumpolar region.

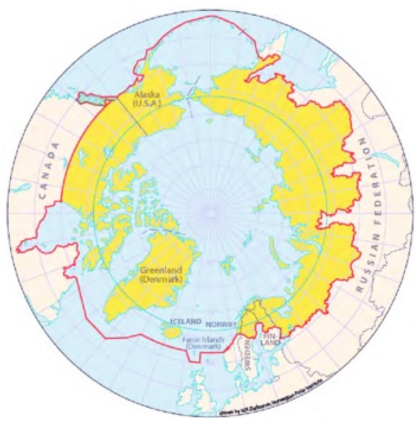
In this chapter I will explore the issues of community health and well-being – two of the many challenges facing all Arctic communities. I will do so by providing examples of these challenges and the strengths and insights that inform local responses and strategies to address these challenges. I will conclude this chapter with a list of actionable recommendations as identified by Arctic scholars who participated in the Fulbright Arctic Initiative II, a U.S Department of State component of the Fulbright Program.

Why Care About Arctic Communities?

Why should anyone outside the Arctic care about our communities? Because to many of us this is our home and homelands are important. In our work as Arctic researchers and scholars, we work with a diversity of Arctic maps, and there is an interesting phenomenon that occurs when people who are unfamiliar with the Arctic share maps of the region; often these maps do not include reference to the people who live in the Arctic. Most often, the maps we see in presentations and reports delineate the Arctic in political terms or broad geographic regions. Such delineations give the false perception that the Arctic is devoid of people and their way of life that has thrived for thousands of years. For example, Figures 2 and 3, are Arctic maps of polynyas and geographical boundaries of the circumpolar region respectively (Arctic Council, 2013 and 2014) neither map indicates community locations. This is a consistent phenomenon. But the communities, the people, are why these maps are important. This region is our home. We care very deeply about what happens here and our home is changing. And what happens in the Arctic is tied very closely to our health and wellbeing. Conversely, what happens outside of the Arctic increasingly has an impact on our health, wellbeing, and way of life.

FIGURE 2: Map of Polynyas in the Arctic (497)

FIGURE 3. Map of the Arctic Region (8)



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Challenges – Health Service Access Issues

Numerous challenges exist in achieving good health and wellbeing in the Arctic, driven by differing interacting determinants. It is well known in Canada, for example, that northerners face a number of challenging circumstances when it comes to achieving good health: e.g. lack of access to services and culturally-appropriate care (20, 21); under-staffed health centres (22); a transient workforce of health professionals; serious issues related to mental wellness & addictions (23-29); historical trauma and acculturation (30-33); and geographically and politically isolated communities (34). That said, there are tremendous strengths in communities to address local health concerns, such as a willingness to work together, traditions and customs that support healthy lifestyles and activity, and strong cultural pride (35-40). Therefore, drawing upon existing community strengths, resources, and pathways to wellbeing is the key to addressing these challenges now and over the coming years.

Furthermore, there are inherent problems with how the information about community health and wellbeing is presented or shared. As a Fulbright Scholar participating in the Fulbright Arctic Initiative II cohort, I had the opportunity to further explore these issues with my colleagues and collectively identify new ways of thinking about and approaches to these topics. To do so meant looking through my own community's lens and lived experiences. The list of critical health-related challenges in the Arctic is growing, not diminishing, and requires community leaders, healthcare providers, regional and national policy leaders, and scholars to reconceptualize and then implement community-based solutions. A description of our population and a snapshot of important determinants of health are below. Systemic and longstanding issues that have gone un-addressed require new and innovative ways of thinking and require a sense of purposeful urgency to affect meaningful change:

- Where, historically, Inuit lived a nomadic life traveling with the seasons and animal migrations, today, there are 25 communities in Nunavut ranging in size from a population of 150 to 7,100 (41). The transition from a nomadic lifestyle on the land to life in these communities is relatively recent – in the living memory of today's Elders - and for this reason, many refer to Nunavut as a 'young' territory. All of the communities are geographically isolated from each other and are only accessible by air, water, or snowmobile in winter. The population of Nunavut in 2016 was 35,944, of whom approximately 85% are Inuit (42). Fifty-two percent of *Nunavummiut*[1] speak the Inuit languages of Inuktitut or Inuinnaqtun at home (43). Nunavut has a very young population compared to Canada as a whole. In 2016, 57.3% of the Nunavut population was comprised of those 24 years of age and younger compared to 29.2% in the whole of Canada (42). In summary, the Nunavut territory has an expansive geography that has been an integral part of Inuit life and spirit for centuries, yet it is a young political entity, and has a young population.

- Nunavut has one hospital (Iqaluit, Nunavut), and two larger health centres in regional communities (Rankin Inlet and Cambridge Bay, Nunavut) staffed by physicians. Health centres staffed by community health nurses service all other regional communities, and physicians make visits to these communities throughout the year. This dearth of services means that patients are often sent to tertiary care facilities in Yellowknife, Northwest Territories, Edmonton Alberta, Winnipeg, Manitoba, or Ottawa, Ontario if more advanced or complex care is required.
- A chronic shortage of housing contributes to overcrowding among many families with young children in almost every community in Nunavut (44, 45). Influences from media, television, education system, and other sources (46-48), as well as residential schooling (49, 50), parents coping with significant stress and mental health and wellness issues (51-55), and settlement into larger communities (34) have contributed to the shift in the traditional way of life in contemporary communities. While relationships with the land remain an integral part of life, participation in the wage economy and the demands of contemporary *urban* life now compete for time in the lives of Nunavummiut.
- Tuberculosis continues to be a challenge in Nunavut. TB continues to impact our population at a rate 62 times the Canadian average (56). Pervasive social determinants in Nunavut such as poverty; lack of adequate

1 Inuktitut (Inuit language) term for ‘people of Nunavut’

housing and overcrowding, food insecurity, and trauma are intermeshed with the quality of life for many *Nunavummiut* (57, 58). Public health services and health promotion initiatives are largely the domain of the Government of Nunavut, Department of Health. These programs consist of maternal-child health support (e.g. well-baby clinics, immunization clinics, breastfeeding support, prenatal nutrition programs), chronic disease management, environmental health, anti-tobacco use initiatives, infectious disease control, oral health, and nutrition and food security initiatives (59).

The Fulbright Arctic Initiative Iceberg Model

How then can we reimagine the way we address and deliver healthcare and wellbeing strategies for our communities? Well, all Arctic communities have a relationship, in one manner or another, with water. In our Fulbright Arctic Initiative Iceberg Model (60), current narratives on health and wellbeing in the Arctic can be visualized as, and can be made analogous to, an iceberg. Researchers are often most interested in exploring the visible part of the iceberg – the information and realities they can "see" or "identify" or "quantify" above the "surface" through data sets – data sets that are routinely (and perhaps uniformly) collected in many countries. As an example, such "visible" data may include health service utilization, doctor-patient ratios, morbidity and mortality data. From the tip of the iceberg perspective, mortality and morbidity indicators across the circumpolar region paint a picture of disparities, with the greatest burdens on Indigenous peoples of the Arctic. For example, medical and demographic statistics reflect health and wellbeing indicators for Indigenous peoples in Canada; the life expectancy of Indigenous peoples in the North is 10-11 years shorter than the general population (57). However, a much larger percentage of the mass of an iceberg lies underneath the water, as do the complex contextual determinants of health and wellbeing in our communities.

As a result, the complex solutions that can be harnessed also remain out of sight, below the surface, if we don't engage the appropriate means to seek them out. These complex community-driven solutions can empower Arctic communities beyond "sustaining" established practices, toward implementing innovations in a time of change so that community direction is self-determined, healthy, and "thriving" into the future. For example, in maternal and child health, healthcare professionals tend to focus on data such as birth outcomes, maternal outcomes, delivery outcomes, rates of intervention, or hospital vs. home births (when available). Factors less frequently examined that could contextualize the previous data and paint a picture of strengths and a roadmap for action lie "below the surface" in our Iceberg Model. These factors can include the use of traditional methods of prenatal care and teachings, intergenerational knowledge sharing, access to traditional foods, ways that ensure social support is given and desired, familiarity and comfort with urban and medical environments, access to services in local languages, cultural competence/safety of care providers, the presence of patient advocates/navigators/allies, and much more.

Inequities persist, and documenting these inequities is an important step toward addressing them. Experts in these fields have noted efforts to document inequities in all countries are needed, given that there are some countries and regions that have yet to do so systematically by including ethnic identifiers in health data (58). However, they also note that the nearly exclusive narrative of rural and Indigenous populations of the north having generally worse health than the dominant cultural groups often distracts from the context of those indicators and community strengths that support wellness below the surface. At times, disparities are noted with simplistic explanations, such as genetic or biomedical differences, which neglect historical and ongoing colonialism or socio-economic challenges, such as destruction of traditional ways of life and habitat, curtailment of unprofitable production based on traditional trades, and unemployment, as well as challenges that result from these shifts, such as changes in nutrition and quality of food and water (60). In order to get a more complete picture of health and well-being in the circumpolar region, the Iceberg Model challenges us to dive below the surface. By doing so, the ways in which Arctic people experience good health could be more comprehensively explored and strengthened, which in turn would inform community-engaged, strengths-based interventions that support holistic wellbeing.

Strengths – Community Perspectives on Wellbeing

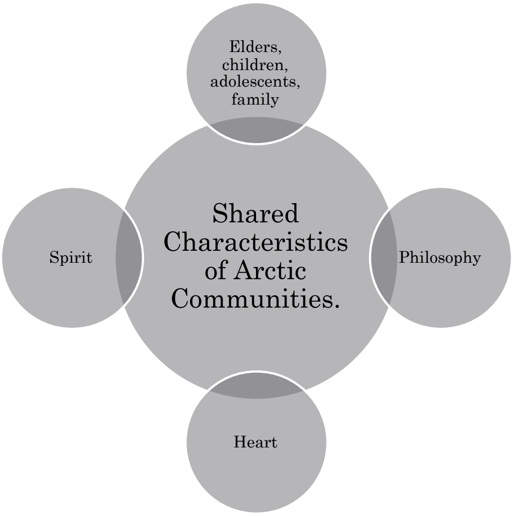
"I ask myself, does it resonate with my family?"

—study participant (61)

"If there is no common language – and maybe that is ok – maybe that is the point… We {Arctic Peoples] share a common philosophy, heart, spirit – and family."

—study participant (61)

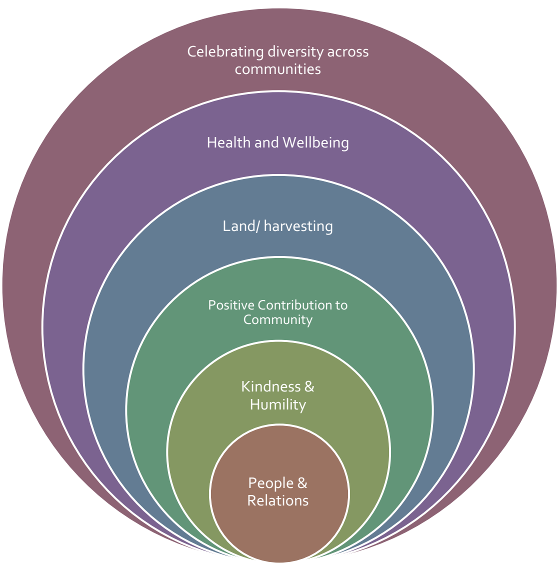
FIGURE 4. Shared Characteristics of Arctic Communities.



Source: Reproduced with permission from Healey Akearok, et al (2019).

In a study of community perspectives on well-being and use of the term "resilience" in the Arctic, participants identified concepts such as "*sisu*" in Finnish, meaning 'perseverance, wellness, or grit'; the German word "*geist,*" which would be used in Sweden to mean 'show some (fighting) spirit'; and "*sila*" in Kalaallisut (Greenlandic), which references how the weather, environment, and one's mind are interconnected (61). The phrase "*Sila naalagaavoq*" in Kalaallisut, meaning "the weather determines the outcome," is an oft-used phrase indicating that events which occur are related to the interaction between the mind/body and what surrounds us (61). In Nunavut, this term also references the weather/environment in Inuktitut[2] and regard for the power they hold over us. In each example, power, humility, and the mind-body-environment relationship are foundational concepts and imagery that underpin well-being concepts across the Arctic. My colleagues and I have proposed a strengths-based conceptual framework privileging the voices of the community members who participated in their discussion (61). This framework highlighted key elements of thriving Arctic communities, including diversity, health, the land and harvesting, the positive contribution of individuals to the community, people, and kindness.

FIGURE 5: Elements of Thriving Arctic Communities (61).

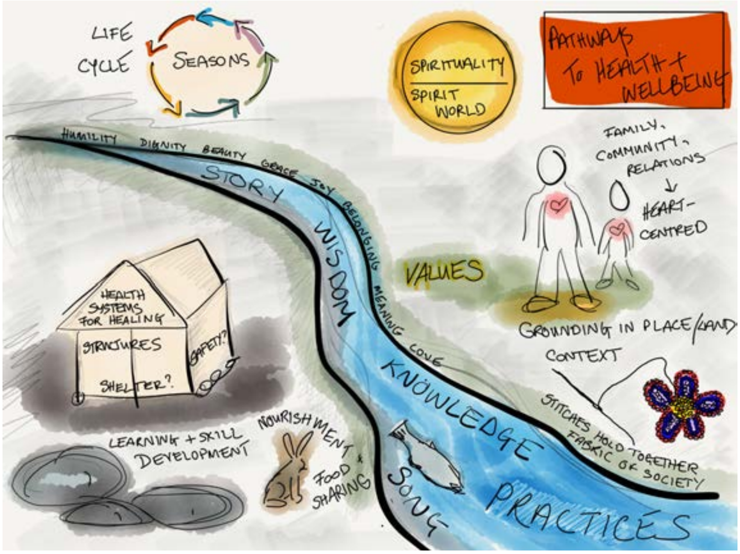


Source: Healey Akearok, G, Cueva, K, Stoor, J, Larsen, C, Rink, E, Kanayurak, N, et al. Exploring the Term "Resilience" in Arctic Health and Well-Being Using a Sharing Circle as a Community-Centered Approach: Insights from a Conference Workshop. Social Science. 2019;8(2):45. *Note*: Adapted by Gwen Healey Akearok from the original publication with permission of the authors:

2 Inuktitut is the local language of Inuit in Canada's Eastern Arctic

Relations and the strength of bonds within thriving northern communities are highlighted in this framework, fostering a sense of accountability, humility, reflection, and love that allows children and others to be honored within their communities. Lived experiences of thriving northern communities revealed open-mindedness about diversity, what it means to be healthy, and recognizing and celebrating diverse ways of living and being. This acknowledgement also highlighted the role of small communities and their connections to the land and animals in facilitating interdependence. This interdependence fostered kindness and humility and contributed to the need to take care of each other, as well as tolerate diversity. Connections to nature and the rhythm of the seasons are also a universal construct in Arctic communities.

FIGURE 6: Pathways to Wellbeing



A depiction of the ways in which well-being perspectives of Arctic Indigenous Peoples are rooted in connections to the environment, the animal world, the spirit world, seasonality (time), and relationships. *Source:* Used with permission of Dr. Gwen Healy Akearok

Community wellbeing is centred around people, particularly elders, but also on children and wellbeing among the youngest members of the community. Community members support each other through informal networks, such as connecting families with older people who are otherwise alone, and through sharing food, including, but not limited to local, traditional, or 'country' foods. When the oldest and youngest members of the community are connected, family, nature/land, and food play central roles in fostering wellbeing.

In summary, community wellbeing perspectives in the Arctic are rooted in people, family, the land/environment, and important values related to food-sharing, kindness, humility, and respect for the world around us.

How Can We Support Thriving Communities?

Policy Recommendations

The Fulbright Arctic Initiative Cohort II team of scholars were divided into groups. The Resilient Communities group of scholars was comprised of eight individuals from throughout the circumpolar North and together developed and addressed research questions relevant to Arctic nations' shared challenges and opportunities. Their work incorporated critical, community-based perspectives on Arctic health and wellbeing, and harnessed strengths-based approaches developed in partnership with Arctic communities (60). This cohort of scholars

Policy Recommendations to Support Thriving Communities	
1	Acknowledge and Integrate Indigenous Rights and Knowledges, including allocating funding for organizations working to advance the rights of Arctic peoples and expanding Arctic Council's Permanent Participants to the same status as States
2	Take Meaningful Action to Address Indigenous Determinants of Health, including supporting local innovation and Indigenous leadership, creating pathways for community priorities to be incorporated into health systems and governance, and incorporating the voices of under-represented groups such as youth and elders
3	Expand Monitoring and Assessment Programs, including establishing monitoring systems that follow Indigenous ethical guidelines, create and expand approaches to assessment, and implement and evaluate community-drive research strategies
4	Implement Community-led, Critical Research Approaches that focus on partnerships, reciprocity, adherence to ethical guidelines, and funding community-based research

developed seventeen (17) policy recommendations in four thematic areas to support health and wellbeing in the Arctic (62):

These recommendations represent a comprehensive set of guidelines to reduce inequities, support Indigenous expertise and existing knowledge, and promote thriving communities in the Arctic.

The recommendations outlined by this cohort validate and also expand upon the Arctic Health Declaration (63), signed by 7 of 8 Arctic states at the 2011 meeting of Arctic Health Ministers:

"We declare our intention to

- *Strengthen circumpolar collaboration on health promotion, disease surveillance and culturally appropriate health care delivery,*
- *Increase circumpolar sharing of knowledge regarding common health opportunities and challenges such as lifestyle related wellbeing, health, and ill-health,*
- *Continue empowerment of Indigenous peoples and other Arctic residents through health promotion and disease prevention, including increased participation in health research by Indigenous peoples and other Arctic residents,*
- *Enhance mental health and prevention of substance abuse and suicides through exchange of experience and good practices,*
- *Extend use of e-health applications including telemedicine as a means of improving health and health care,*
- *Continue efforts to improve and sustain long term observation, monitoring and surveillance of diseases and changes in the Arctic health including circumpolar comparative studies to identify lessons learned, best practices, and innovative models and approaches for improving health,*
- *Increase circumpolar cooperation on assessing, mitigating and adapting to the health impacts of climate change and environmental impacts on health,*

- *Enhance cooperation regarding health promotion and research with relevant Arctic Council observer organizations, regional bodies, and the World Health Organization."*

The Path Forward

I have had the good fortunate of co-teaching a course with my namesake, Aalasi, a community Elder, for the last 8 years. In our time together, which brings us a lot of joy and laughter, she has often reminded me in her own indirect way that I am infant in my understanding of the world. I may have degrees and certifications, but my life knowledge is in the early stages of development. In order to live a meaningful life, she and other Elders have instructed us that we must act from the heart – to be 'heart-centred' is the greatest moral characteristic we can possess. When we take action from the heart, the mind will surely follow, is what they say. When reflecting on the pathways forward for our communities in a changing Arctic, the Elders and community members that I have learned from would tell me that it is important to persevere, to act from the heart, and to lead by example.

In my own work and life, I have and continue to make space for the recommendations outlined in this chapter, to elevate them to different decision-makers and governments, and to act through the avenues I have available to me, so that future generations will not have the same challenges. I also continue to pursue ongoing research so that we have access to and can incorporate the most up-to-date and relevant findings and strategies into our work. I continue to build and nurture the relationships that will support my community to thrive in a holistic way.

I would like to invite the readers of this chapter to do the same: to develop meaningful connections and relationships, to take action in a heart-centred way, to move forward with future generations in mind, and to remember the human dimension of the Arctic in all that you work to achieve.

ABOUT THE AUTHOR

Dr. Gwen Healey Akearok was born and raised in Iqaluit, Nunavut and it is in this community that she continues to live, work, and raise her family. Gwen is co-founder and Executive and Scientific Director of the Qaujigiartiit Health Research Centre (AHRN-NU) in Iqaluit, NU. She holds a Master's degree in Epidemiology & Community Health Sciences from the University of Calgary and a PhD in Public Health from the University of Toronto.

Dr. Healey Akearok co-founded the Qaujigiartiit Health Research Centre in 2006 with the late Elder, Andrew Tagak Sr.. The goal of the Centre is to enable health research to be conducted locally, by northerners, and with communities in a supportive, safe, culturally-responsive and ethical environment, as well as engage Inuit and western methodologies and epistemologies in addressing health concerns, creating healthy environments, and improving the health of Nunavummiut.

Since Qaujigiartiit's inception in 2006, Dr. Healey Akearok has successfully brought over $28 million dollars in research and training grants into Nunavut, and more than 1500 Nunavummiut have led, partnered on, or participated in research projects and training workshops in Nunavut during that time. All of the data has remained in Nunavut, been used to advance programming and services for Nunavummiut, and much has been published in the peer-reviewed and non-peer-reviewed literature.

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COOPERATION

Image source: 12th Arctic Council Ministerial meeting Handing over the gavel from the Icelandic to the Russian Chairmanship. Photo by: Icelandic Ministry for Foreign Affairs/ Gunnar Vigfússon / Flickr.com

By Ambassador David Balton

Navigating the Future of Cooperation in the Arctic

Since the end of the Cold War, the Arctic region has attracted increasing geopolitical attention, driven largely by a warming climate. During this period, a more accessible Arctic has witnessed notable advances in commercial activity, particularly oil and gas exploration, communications, port infrastructure, tourism, and shipping. At the same time, climate change has already altered the Arctic environment in profound ways, raising alarms about the effects of a warming Arctic on the rest of the planet.[1]

The warming of the Arctic over the past 30 years has also coincided with a remarkable growth in international institutions and arrangements intended to manage expanding human activity in the Arctic and deepen human understanding of the region. Despite serious tensions between Russia and other Arctic nations concerning other regions and other issues, Arctic governments have largely chosen to compartmentalize the Arctic—to set aside those tensions in favor of cooperating with each other in the region.

During the latter part of the Trump Administration, however, the spirit of international cooperation that largely characterized the Arctic since the end of the Cold War came under threat. The United States reversed course on the key issue of climate change and found itself seriously out of step with other Arctic governments. But changes in U.S. climate policy strategy were not the only challenge to ongoing cooperation in the Arctic. Russia has stepped up its efforts to rebuild its military infrastructure and to expand its capabilities in the Arctic. It has also engaged in provocative actions against the West. China, declaring itself a "near-Arctic state," has sought to increase its influence in the region in ways that have caused concern.[2]

12th Arctic Council Ministerial meeting Family photo.
Source: Icelandic Ministry for Foreign Affairs /Gunnar Vigfússon / Flickr.com

In a speech in Helsinki on May 6, 2019, U.S. Secretary of State Mike Pompeo referred to the Arctic as "an arena for power and competition … complete with new threats to the Arctic and its real estate, and to all of our interests in that region."[3] The following day, the Arctic Council failed—for the first time in its history—to reach agreement on a Ministerial Declaration, reportedly because the United States refused to accept language referring to climate change.[4]

The advent of the Biden Administration has ushered in another reversal, one highlighted by a renewed U.S. intention to fight climate change and to work through multilateral bodies including the Arctic Council. Mike Pompeo's successor, Antony Blinken, articulated this approach in his statement at the 2021 Arctic Council Ministerial: "We're committed to advancing a peaceful Arctic region where cooperation prevails on climate, the environment, science and safety, and where sustainable economic development benefits the people of the region themselves. This council is indispensable to this vision."[5]

This chapter examines the rise of the Arctic as a cooperative, rules-based, low-threat region over the past 30 years. It reviews the establishment and evolution of the Arctic Council and other international institutions and arrangements that have both reflected and fostered cooperation among governments, Indigenous peoples, and stakeholders in the Arctic. The period from 2014 to 2019 deserves special mention in this regard. Despite Russia's invasion of Crimea, resulting sanctions, and other sources of tension involving Syria and election interference, the period of Arctic cooperation not only continued but arguably strengthened. The chapter also considers whether a recent, new dynamic in the international relations concerning the Arctic, one marked by "Great Power Competition," will spell an end to Arctic cooperation, or whether the governments concerned will choose to restore and maintain cooperative relations in the region. Finally, the chapter offers a number of recommendations for navigating the current geopolitical environment of the Arctic.

The Rise of Arctic Cooperation: 1990–2013

The Arctic emerged as a low-tension region actually before the end of the Cold War. In a 1987 speech in Murmansk, Soviet leader Mikhail Gorbachev called for the Arctic to be a zone of peace, a region in which Arctic states could and should pursue common interests.[6] Perhaps ironically, the collapse of the Soviet Union a few years later allowed this vision to come to fruition.

In quick succession, by the standards of international relations, the 1990s witnessed the creation of the International Arctic Science Committee (1990), the Arctic Environmental Protection Strategy (1991), and the Arctic Council (1996), among other developments relevant to the region.[7] Although the Ottawa Declaration did not provide the Arctic Council with legal personality or the ability to make binding decisions, it did give the Council a broad mandate to address "common Arctic issues," with a particular focus on environmental protection and sustainable development. Indeed, the only issue expressly excluded from the Council's remit was—and still is—military security. The Ottawa Declaration also represented a solemn commitment to include Arctic Indigenous peoples in all Council activities, represented by Permanent Participant groups (and not as part of national delegations).

During its first decade or so, the Arctic Council generally operated below the political radar as far as the United States was concerned. While other Arctic

Council Members, including Russia, typically sent their Foreign Ministers to the biennial high-level Council sessions, the United States did not. The Council in this period nevertheless undertook numerous projects to improve life in, and expand knowledge of, the region, including the Arctic Climate Impact Assessment (2005).[88] It also admitted a significant number of non-Arctic states, international organizations, and non-governmental organizations as observers.

The ACIA and similar studies raised real concerns about the extraordinary environmental changes underway in the Arctic, pointing to even greater changes to come. To address those changing conditions, some governments and interest groups issued proposals for a stronger international architecture to supplement, or even replace, the Arctic Council—perhaps an international agreement or agreements similar to the Antarctic Treaty System. In 2008, five Arctic governments—those with coastlines on the Central Arctic Ocean—reacted to these proposals by adopting the Ilulissat Declaration, which both reaffirmed their commitment to the existing international governance framework and stated that there was "no need to develop a new comprehensive international legal regime." [9]

In retrospect, the Ilulissat Declaration appears to have represented a momentary pause in the evolution of international cooperation concerning the Arctic. While no "comprehensive international legal regime" has come into existence, the governments concerned have since 2008 created a sprawling new international governance architecture for the Arctic. They enabled the Arctic Council to evolve in ways that its founders probably would not have predicted. They also negotiated no fewer than five specific treaties for the Arctic in the decade following the Ilulissat Declaration, and created a few more Arctic-based institutions.

For its part, the United States started paying greater heed to developments in the Arctic following the Ilulissat Declaration, in large part due to the Obama Administration's increased focus on the climate change agenda. In 2011, Hillary Clinton became the first U.S. Secretary of State to attend an Arctic

Council Ministerial, setting a precedent that each future Secretary of State has followed. Secretary Clinton joined her counterparts from the other seven Arctic states in signing the first of the treaties mentioned above, on improving search and rescue cooperation in the Arctic.[10] Two years later, the Ministers signed the second such treaty, on strengthening cooperation on marine oil pollution preparedness and response.[11]

Arctic Exceptionalism: 2014-2018

Serious disputes between Russia and Western governments over the Syrian conflict date back at least to 2011. Those frictions became more acute in the wake of the Russian invasion of Crimea in 2014, Russian support for anti-government forces in Eastern Ukraine, and Russian interference in the 2016 U.S. elections, among other concerns. Western governments, led by the United States, imposed economic sanctions on Russia following the invasion of Crimea; the Russian government responded with its own sanctions on the West. Military-to-military contacts between Russia and the West virtually ended and have not resumed. Diplomatic relations in general became antagonistic, even hostile.

Despite these strong headwinds, international cooperation concerning the Arctic region remained largely unaffected through the end of 2018. Indeed, the period from 2014 to 2018 may arguably represent the high point in the history of cooperation in the Arctic. For a variety of reasons, the Arctic states generally chose to "compartmentalize" the Arctic during this period, choosing to collaborate in pursuit of their mutual interests in the region as though the Arctic were insulated from problems elsewhere.[12] International cooperation during this time yielded a variety of noteworthy accomplishments, including:

- **A stronger Arctic Council**

  The Council expanded its reach, successfully undertaking impressive programs and projects. Arctic Council Members and Permanent Participants also improved the structure and operations of the Council, creating a permanent Secretariat for the Council, improving tracking of its numerous projects, integrating Indigenous knowledge into its work, and admitting additional Observer States and organizations. The Council itself received a nomination for the Nobel Peace Prize, in recognition of its contributions to the maintenance of the Arctic as a low-tension region.

- **Improved management of Arctic shipping**
  The International Maritime Organization (IMO) adopted a series of measures to make Arctic shipping safer and more environmentally secure. Known as the Polar Code, these measures became effective in 2017. The following year, the IMO adopted a ship traffic separation scheme for the Bering Strait region, jointly proposed by the United States and Russia.
- **Conclusion of the Arctic Fisheries Agreement**
  In 2017, nine states and the European Union concluded negotiations on a treaty to delay the advent of commercial high seas fishing in the Central Arctic Ocean for at least 16 years. The treaty, signed the following year, also contains a commitment to create a Joint Program of Scientific Research and Monitoring related to possible future fisheries in this area, as well as a commitment to include Arctic Indigenous peoples in its implementation. Hailed as an extraordinary example of the "precautionary approach" in action, the Central Arctic Ocean Fisheries Agreement also represented the first treaty concerning the Arctic that included non-Arctic states (and the European Union) on an equal footing with Arctic states.[13]
- **Creation of new Arctic institutions**
  As one of the signature initiatives of its Arctic Council chairmanship, Canada proposed the creation of the Arctic Economic Council (AEC), which formally launched in 2015. The AEC is an independent, private-sector organization that facilitates business-to-business activities and responsible economic development by sharing best practices, technological solutions, standards, and other information. In 2015, the Arctic states also established the Arctic Coast Guard Forum as a platform to foster safe, secure, and environmentally responsible maritime activity in the Arctic.

- **Promotion of Arctic science**
  In 2016, the United States convened the first Arctic Science Ministerial Meeting, bringing together officials from 24 governments and the EU, as well as representatives of Arctic Indigenous organizations. Their discussions centered on collective efforts to step up international scientific cooperation in the Arctic. A second Arctic Science Ministerial took place in Berlin the following year. At the 2017 Arctic Council Ministerial Meeting in Fairbanks, foreign ministers of the Arctic states also signed yet another treaty, one designed to enhance scientific cooperation throughout the region. Russia and the United States co-led the negotiations that produced this agreement.
- **Heightened U.S. engagement**
  Throughout this period, the United States increased its engagement on international Arctic issues. A visit by Barack Obama to Alaska in 2015 constituted the most visible symbol of this engagement—the first trip by a sitting U.S. President to the Arctic. While in Alaska, President Obama led an international conference on climate change and other Arctic concerns, in part to build support for the Paris Agreement that was then under negotiation. The United States also brought considerable ambition and effort to its chairmanship of the Arctic Council between 2015 and 2017.

Threats to International Cooperation: 2019–2020

It is tempting to point to the start of the Trump Administration as the moment when "Arctic exceptionalism" came to an end. The summary above of significant achievements produced through international cooperation reveals a more nuanced reality, however. Several of those achievements took place, or at least came to fruition, during 2017 and 2018, after President Trump took office. Under President Trump, the United States signed and ratified both the Arctic Fisheries Agreement and the Arctic Science Cooperation Agreement. The United States also brought to successful completion its U.S. chairmanship of the Arctic Council in May 2017, notwithstanding the need for some last-minute adjustments to the Fairbanks Declaration sought by Secretary of State Rex Tillerson.[14]

That said, the Trump Administration bears significant responsibility for a downturn in Arctic cooperation in this period. The "America First" approach to U.S. foreign policy on which Donald Trump campaigned for the presidency signaled a disregard for—even an antipathy toward—multilateral regimes and arrangements of the sort that had proliferated in the Arctic over the past two decades, the very regimes and arrangements that had helped to keep tensions in the region low and manageable.

On the central issue of climate change, the United States under President Trump broke ranks with other Arctic states (and, indeed, with the international community at large). The dramatic changes in approach did not begin immediately after President Trump's inauguration, however. As noted above, in May 2017, Secretary Tillerson joined other Foreign Ministers in signing the Fairbanks Declaration at the conclusion of the U.S. chairmanship of the Arctic Council. That Declaration pointed out "that the pace and scale of continuing Arctic warming will depend on future emissions of greenhouse gases and short-lived climate pollutants" and highlighted "the importance of global action to reduce both greenhouse gases and short-lived climate pollutants to mitigate climate change."

Roughly three weeks later, though, President Trump abruptly changed course, announcing the U.S. intention to withdraw from the Paris Agreement.[15] Over the next three years, the United States abandoned the leadership role in combatting climate change that it had played at the international level, while also weakening domestic measures to curb greenhouse gas emissions. It is difficult to overstate the effect that these changes have had on relations among the Arctic states and their ability to continue cooperating to address the Arctic's signature issue. As noted above, one measure of that effect became apparent at the 2019 Arctic Council Ministerial, in Rovaniemi, Finland. The inability of the Arctic Council to produce an agreed upon Declaration—due to the unwillingness of the United States to accept language concerning climate change—represented a serious breakdown in diplomacy.

Other forces certainly contributed to this breakdown. The Russian Federation has in recent years taken a series of provocative and aggressive steps to enhance its Arctic posture. Among them, it has modernized its Northern Fleet based in the Kola Peninsula, renovated its military installations throughout the Russian Arctic, and expanded its fleet of ice-breakers. While a number of these measures, particularly the building of new ice-breakers, may spring from the Russian government's economic rather than military motives, one cannot so easily dismiss all Russian actions as innocuous.

In February 2020, for example, Norway determined that Russia had jammed GPS signals during a NATO exercise in the Arctic known as Trident Juncture. Finland also expressed concern over Russia's jamming of signals in Lapland.[16] The following month, Russia sent reconnaissance aircraft flying over U.S. submarines that surfaced in the Beaufort Sea during another exercise known as ICEX.[17] In short, while Russia still claims it desires continued cooperation in the Arctic—particularly as Russia prepared for its Arctic Council chairmanship that began in 2021—the actions of its military and security agencies suggest otherwise.

In its own way, China has also contributed to rising tensions in the Arctic region. Though not an Arctic state—given that its closest point is some 900 miles from the Arctic Circle—China has sought to influence events in the Arctic, primarily through its substantial economic investments in certain locations in the Arctic, particularly in Russia. In January 2018, the Chinese government also issued "China's Arctic Policy"—a paper that, on its face, largely emphasized China's respect for international law concerning the Arctic and its desire to cooperate with Arctic nations and peoples.

But it also made clear China's intentions to advance its own interests in the region, particularly by calling for Arctic development to unfold as a "Polar Silk Road" that fit within the framework of China's Belt and Road Initiative.[18] The 2018 Chinese policy paper, coupled with large-scale Chinese involvement in Russian Arctic infrastructure projects that undermined Western sanctions against Russia, caused serious consternation on the part of the United States, Canada, and the Nordic nations.

These three developments—the reversal of U.S. climate change policy, provocative Russian posturing, and China's assertion of influence in the Arctic—combined to threaten continued cooperation in the Arctic. The COVID-19 pandemic made matters worse in 2020 and early 2021, causing the cancellation or postponement of many diplomatic events where government officials and other participants might have found ways to work through the current difficulties.

While the Biden Administration's commitment to addressing climate change, in both domestic and foreign policy, will almost certainly ease one of the key sources of tension that arose in Arctic diplomacy, the threats to Arctic cooperation presented by Russia's and China's actions show no signs of abating. Indeed, the U.S.-Russia relationship may actually worsen in the coming years, even as Russia chairs the Arctic Council from 2021 to 2023. A central question for those concerned with the Arctic will be whether the governments in question will return to the practice of compartmentalizing the Arctic—that is, pursuing cooperation in the Arctic even while they confront each other over other regions and other issues.

The Path Forward

In describing the Arctic as an arena for power and competition, Secretary Pompeo spoke as though such a state of affairs is inevitable or immutable. In fact, the question of whether to pursue competition or cooperation in the Arctic, or some combination of the two, remains a policy choice. A sober assessment of the circumstances of the Arctic suggests that the Arctic states, and even key non-Arctic states, have much more to gain by enhancing cooperation and reducing competition.

The likelihood of armed conflict in the Arctic is quite small, notwithstanding Russia's military build-up (and U.S. responses to that build-up). Growing Chinese influence in the Arctic, while worrisome in certain respects, is similarly unlikely to alter the basic dynamics of relations among the Arctic nations, and certainly will have no bearing on the recognized sovereignty that each Arctic nation enjoys. In this regard, Secretary Pompeo's 2019 speech erred in claiming the existence of threats to the Arctic's "real estate." There are no territorial disputes in the Arctic of any consequence. Although the Arctic does contain significant natural resources, including hydrocarbons, the notion that competition over the development of those resources will produce armed conflict is, at best, attenuated.

The most pressing problems of the Arctic do not, in fact, relate directly to national security. Instead, they have to do with: (1) a climate that is warming at roughly three times the global average, and the alterations to the natural systems of the Arctic that have already taken place as a consequence; and (2) socioeconomic concerns, particularly in North America, Greenland, and parts of the Russian Arctic, some of which have grown more acute due to climate change. These problems, and the resulting challenges of managing increasing human activity in a more accessible Arctic while allowing Arctic communities to develop sustainably, for the most part have created common cause among Arctic states and stakeholders to find common solutions through international cooperation.

What path will the Arctic follow in the coming years? Will the vision of the Arctic as an arena of power and competition become a self-fulfilling prophecy? Or will the Arctic manage to rekindle the spirit of cooperation that has generally characterized international relations in that region since the end of the Cold War?

Recommendations for Rekindling Cooperation

If policymakers choose the latter path—a resumption of cooperative engagement in the Arctic—they will find a number of opportunities for strengthening and better coordinating the current international regime for the Arctic. They could:

- **Strengthen the Arctic Council system.** The Arctic Council, despite its remarkable evolution, still lacks adequate and predictable funding and a consolidated secretariat. Its current structure, put into place in 1996, may no longer reflect, or be best able to respond to, the present needs of the region.[19] The Council also has no real practice of reporting on the implementation of decisions it has taken, raising questions about its commitment to accountability and transparency. The adoption of the

Timeline of Arctic Cooperation

1991

Arctic Environmental Protection Strategy (AEPS) Signed

Canada, Denmark, Iceland, Finland, Norway the Soviet Union, Sweden and the United States establish a framework for intergovernmental cooperation on environmental protection initiatives in the Arctic.

1996

Arctic Council Established

The eight Arctic states sign the Ottawa Declaration, establishing the Arctic Council. Six Indigenous Peoples Organizations (IPOs) join as Permanent Participants:

- Aleut International Association
- Arctic Athabaskan Council
- Gwich'in Council International
- Inuit Circumpolar Council
- Russian Association of Indigenous Peoples of the North
- Saami Council

2008

Ilulissat Declaration Signed

Canada, Denmark, Norway, Russia and the United States agree to work together on issues concerning management of human activities in the Arctic Ocean.

Council's first-ever long term strategic plan in 2021 offers a framework for addressing these limitations, if policymakers have the desire to do so.[20]

- **Improve overall governance of the Arctic Ocean.** The warming of the Arctic and the attendant reduction in sea ice has made the Arctic Ocean dramatically more accessible. Commercial shipping has already increased, particularly along Russia's Northern Sea Route, with further increases expected. The Arctic Ocean remains poorly understood and poorly charted, however. Current arrangements and rules relating to the Arctic Ocean—including the Arctic Council, the IMO's Polar Code, the Arctic Fisheries

2011

Arctic Search and Rescue Agreement Signed

The eight Arctic states agree to coordinate international search and rescue coverage and response in the Arctic, and establish areas of SAR responsibility for each Party. Agreement enters into force 2013.

Arctic Oil Pollution Preparedness, and Response Agreement Signed

The eight Arctic states agree to cooperate on marine oil pollution preparedness and response, including by providing mutual assistance to each other as needed, by promoting the exchange of information to improve the success of response operations and by carrying out joint training and exercises in the Arctic environment. Agreement entered into force 2016.

2013

2017

Ilulissat Declaration Signed

Canada, Denmark, Norway, Russia and the United States agree to work together on issues concerning management of human activities in the Arctic Ocean.

2018

Central Arctic Ocean Fisheries Agreement Signed

Nine States and the European Union agree to forego commercial fishing in the high seas portion of the Central Arctic Ocean. Agreement entered into force 2021.

Agreement, and the Arctic Coast Guard Forum—may not prove either sufficiently robust or sufficiently well-coordinated to manage increasing human activity in that ocean in the coming years. States concerned could improve this regime by creating a marine science body for the Central Arctic Ocean and, sometime thereafter, creating a marine management body for the Central Arctic Ocean.[21]

- **Reduce strategic tensions.** The lack of military-to-military contacts between Russia and Western governments that has existed since the invasion of Crimea has an understandable political logic, particularly in the United States. But this situation also has the effect of undermining communication and increasing the risks of miscalculations by national security officials on both sides. The governments in question should create some non-political mechanism, perhaps similar to the meetings of the Arctic Chiefs of Defense that occurred before 2014, to reduce these risks.

Editor's Note: The Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean entered into force on June 25, 2021.

11th Arctic Council Ministerial Meeting in Rovaniemi.
Source: Jouni Porsanger / Ministry for Foreign Affairs of Finland / Flickr.com.

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Ambassador David Balton serves as the Executive Director of the US Arctic Executive Steering Committee. Balton previously served as Senior Fellow in the Polar Institute at the Woodrow Wilson Center. He served as the Deputy Assistant Secretary for Oceans and Fisheries in the Department of State, attaining the rank of Ambassador in 2006. He coordinated U.S. foreign policy concerning oceans and fisheries, as well as issues relating to the Arctic and Antarctica, and oversaw U.S. participation in international organizations dealing with these issues. Ambassador Balton functioned as the lead U.S. negotiator on a wide range of agreements and chaired numerous international meetings. During the U.S. Chairmanship of the Arctic Council (2015-2017), he served as Chair of the Senior Arctic Officials. He also co-chaired Arctic Council Task Forces that produced the 2011 Arctic Search and Rescue Agreement and the 2013 Arctic Oil Pollution Agreement. He separately chaired negotiations to produce an Arctic fisheries agreement. Ambassador Balton received an A.B. from Harvard College and a J.D. from Georgetown University. He appeared with the National Symphony Orchestra (juggling oranges).

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COMPETITION

Image source: Capt. Jack Fine and Senior Airman Sergio Barcena-Turner simulate a patrol March 3, 2014, at Sixmile Lake, Joint Base Elmendorf-Richardson, Alaska. (U.S. Air Force photo by Staff Sgt. Sheila deVera/Released) / Flickr.com

By Dr. Stacy Closson and Mr. Jim Townsend

Navigating the Future of Competition in the Arctic

INTRODUCTION

The Arctic nations, all members of the Arctic Council, include five NATO members (Canada, Denmark, Iceland, Norway, and the United States), close NATO partners (Finland and Sweden), and Russia. Competition in the Arctic directly involves these nations and a non-Arctic nation that is relatively new on the scene—China.

The Arctic's strategic location and natural resources have made it a competitive arena between nations for centuries, beginning with a race to first reach the North Pole. Today, healthy competition exists among Arctic nations in commerce, commodities, tourism, trade, and technology. However, one potentially disconcerting aspect of that competition is the development of military capacity in the region and the risk that it will escalate into conflict.

The Arctic nations seek a low-tension environment, maintaining the region as an exception to conflict elsewhere in the globe. The Arctic region has layers of rules that shape action and negotiation. International law successfully governs states' rights over resources, and complex problems encourage states to negotiate.[1] Indeed, the Arctic states have succeeded in handling disagreements and keeping reactions to a minimum, which can be attributed to the complex interdependence of the powers.[2]

The Arctic Council is one of the few international bodies with a continuing history of fruitful discussions and successful conflict management. However, the Council lacks the ability to bind countries in agreements, nor does it opt to address harder security concerns in the region. But, as in past instances, helps to facilitate binding agreements. Moreover, its membership is limited to the titular states of the Arctic, and extra-regional actors seeking greater positions within the region can only act as Observers.

The Arctic is no stranger to military conflict. It played an important role during World War II (when Russia and the United States were allies), and was an active theater during the Cold War (when they were enemies). However, the Cold War security environment remained predictable and no direct military conflict occurred. The immediate post-Soviet period provided a respite, where competition was relegated to the fields of diplomacy and commerce.

Since the 2010s, military tension in the Arctic has increased. The Arctic nations, most particularly the United States and Russia, have increased their force presence and operations tempo, surveillance capacities, and military bases. They have declared their preparedness to defend national interests in the Arctic by force. At the same time, communication between the NATO Arctic nations and Russia has decreased, making it more difficult to discern intent, thereby increasing the potential for mistaken threat perceptions and erroneous, provocative counter-reactions. Meanwhile, China flexes its rising global power, naming the Arctic region a national security interest, and itself as a major player.[3]

The region's long record of stability is at risk as it becomes an area of focus in the broader Great Power competition. The global balance of power is shifting along with the climate, and the Arctic may emerge as an arena of contestation over natural resources and control of waterways. This is particularly likely if the United States disengages from global leadership and a dissatisfied China or Russia increases in strength and uses force to change the status quo.[4] Likewise, if institutions governing the region weaken or fail to adapt to the evolving security situation, the risk of conflict will grow.[5]

This chapter asks: What factors may lead to an increase in military competition in the Arctic between the United States and Russia? And how do we ensure that competition does not escalate into military conflict? In getting to answers, we first describe the history of military competition in the Arctic during the Cold

War through 2017. Second, we address the factors that have caused military competition to intensify in the Arctic in recent years. And third, we assess the potential types of military conflict most likely to emerge. Finally, we offer policy considerations to control and manage this competition.

HISTORY OF MILITARY COMPETITION IN THE ARCTIC[6]

From the Cold War to 2017

The Role of the Arctic in the Cold War

When the Cold War began, the leap in military technology amplified the strategic geography of the Arctic for both the United States and the Soviet Union. Long-range bombers and later Intercontinental Ballistic Missiles that could fly over the North Pole between the Soviet Union and the United States became the primary threat of attack. In the 1970s, submarines became capable of launching ballistic missiles.

For the Soviet Union, these submarines, as well as a large surface fleet and combat aircraft, were largely based in the Russian Arctic at a Soviet bastion surrounding the Kola Peninsula, home of the Northern Fleet headquartered at Severomorsk. Russia also developed a string of airbases, radar stations, and anti-aircraft batteries to defend its High North stretching from the Atlantic to the Pacific Oceans. To reach the North Atlantic and threaten North American reinforcement routes to Europe, the Soviet navy had to slip through one of the most strategic choke points of the Cold War—the Greenland-Iceland-UK-gap (GIUK gap), the super highway between the Russian Arctic and the North Atlantic. Many of the air intercepts of Soviet aircraft by U.S. and Canadian fighters took place over the Bering Sea near Alaska.

NATO allies poured billions into air defense and anti-submarine warfare (ASW) to keep the Soviet Northern Fleet out of the North Atlantic. The U.S. military established two air bases in Greenland, one (Thule) hosting sophisticated Ballistic Missile Early Warning (BMEWS) radar to detect Russian missile launches. Radars also dotted southern Greenland. Iceland, the gatekeeper of the GIUK gap, bristled with Allied aircraft of all types on Naval Air Station (NAS) Keflavík. There, Allied ASW aircraft and crews became experts in tracking Soviet submarines in the tricky North Atlantic and Norwegian Seas. This strategically important area also became a potential Arctic battleground, as U.S. and Soviet submarines shadowed each other under the ice.

To meet the Cold War threat in Alaska, the United States established the Alaska Command, charged with the defense of Alaska and supported by nine military facilities. Alaska played a critical role early on when the United States and Canada built a multilayered air defense system comprised of early warning radars strung from Hawaii across the top of Alaska, Canada, Greenland, and Iceland. Alaska was a key link in this chain, which included the "North Warning" system high in the Arctic and further south as part of the Distant Early Warning (DEW) line of radars as well as air interceptor bases and air defense batteries to intercept Soviet bombers (and later missiles) flying over the Pole. To tie all these sensors, communication nodes, and aircraft together into a unified air defense net, the United States and Canada established the North American Air Defense Command (NORAD).

End of the Cold War in the Arctic: From War-Footing to Peacetime

At the end of the Cold War, the United States and Europe began to dismantle much of their military structure and peace became the norm. In Canada and Alaska, the DEW line was dismantled and some airbases closed (North Warning and NORAD remained). In Greenland, Thule and its BMEWS radar remained. NAS Keflavík in Iceland was closed in 2006 and U.S. Navy submarines did not operate as often under the Arctic ice. Finally, the NATO strategic command in Norfolk, Virginia, was charged with securing the Atlantic sea lanes, and Supreme Allied Command Atlantic (SACLANT), was renamed Allied Command Transformation (ACT) and given a new mission—to help transform NATO beyond the Cold War.

In Russia, the mighty Northern Fleet bastion remained, but many of its submarines and ships were abandoned and deteriorating pier side. Nordic neighbors grew alarmed that radioactive cores that had been dumped into the harbor would likewise deteriorate. Former Soviet military facilities that once stood watch in the Russian Arctic were also abandoned, and air intercepts of Soviet and Western aircraft ended.

Military Competition Returns to the Arctic

Tensions between Russia and the West began to increase visibly after the Russian invasion of Georgia in 2008. Russian President Vladimir Putin began to rebuild the Russian military, including new classes of submarines, surface vessels, and combat aircraft (all with updated munitions), as well as more sophisticated training and exercises.

After the Russian invasion of Ukraine in 2014, NATO allies raced to strengthen conventional deterrence in Europe. Soon, the rhetoric and military movements between Russia and the West began to echo the Cold War, extending to the Arctic. By 2016, the United States resumed flying aircraft from Iceland to rebuild US Arctic ASW capability that went dormant after the end of the Cold War. Norway and the UK also upgraded their ASW fleet with modern maritime patrol aircraft and the United States signed bilateral defense agreements with the Nordic nations to increase defense cooperation and help build a stronger regional deterrent.

Russia

Russia views its leadership role in the Arctic, both in unilateral and multilateral terms, as a means to sustaining its global stature. Russia has three major visions in the Arctic that support this goal: to ensure Russia’s sovereignty over its exclusive economic and continental shelf, to protect its Arctic zone economic interests that are projected to constitute 20 percent of future GDP growth, and to demonstrate that Russia possesses world-class military capabilities that can be deployed globally.[7]

Russian strategic doctrine has progressively focused on defending its national interests in the Arctic against a growing external threat. Russia's Military Doctrine of 2014 calls the Arctic a strategic priority and calls countering the threat from NATO a top priority. Russia's National Security Strategy envisions a global competition to secure and develop Arctic resources, most of which are in Russia.[8] And Russia's latest Arctic Strategy to 2035 focusses on developing and securing its Northern Sea Route, a passage that it claims encompasses internal waters linking the Atlantic and Pacific oceans.[9]

Putin adjusted the Russian command structure to ensure Russia could monitor and control its Arctic territory. He put the Arctic under a Russian military commander and established the Northern Fleet Joint Strategic Command, making it a fifth military district with a focus on the Arctic region. Moscow also began to open and upgrade formerly shuttered Soviet military facilities in the Arctic. According to the Center for Strategic and International Studies (CSIS), Russia opened 50 previously closed Soviet-era military facilities and refurbished 13 air bases, 10 radar stations, 20 border outposts, and 10 emergency rescue stations.[10]

Beginning in Russia's eastern Arctic area on the Bering Strait, Russian military presence started small with the deployment of the Sopka-2 radar systems on Wrangel Island to detect and monitor aircraft and ships entering the Northern Sea Route. Russia has deployed more sophisticated air defense systems, according to CSIS, such as the Bastion-P and Pantsir-S1 systems, on Kotelny Island and Novaya Zemlya. The purpose of these systems is to create a coastal defense arrangement that secures territory deeper into the central Arctic.

But it is the western approaches to Russia's Arctic and home of the Northern Fleet that has received the greatest Russian military attention, including (according to CSIS) potential offensive capabilities. Remote locations like Alexandra Land (the largest island in Franz Josef Archipelago in the Arctic Ocean) are equipped with air, sea, and land capabilities. The focus of these defenses is to safeguard Russia's nuclear arsenal and second-strike capabilities commanded by the powerful Northern Fleet.

Of particular concern to Western analysts, the newly refurbished Russian Arctic bases are able to use the upgraded Russian air defense technology to form an Anti-Access/Area Denial (A2/AD) barrier in the Kola Peninsula/Barents Sea area to protect the Northern Fleet from air or sea attack. Russia supplements this A2/AD barrier with air patrols that range down as far as the English Channel, as well as anti-ship missile systems. An A2/AD barrier can weaken NATO deterrence if Russia believes their barrier cannot be penetrated by Allied forces, providing cover for the Russians to safely conduct offensive operations.

To send a pointed message to its neighbors that Russia is back, Russian aircraft have simulated air attacks on Norwegian radar, jammed Norwegian communications during exercises, and harassed U.S. and Allied ships in the Norwegian Sea and in the Baltic Sea. Strategic Long-Range Ballistic Missiles (SLBM) tests have also been conducted in the Barents Sea, demonstrating that the Russians can now launch nuclear missiles from the Barents and not have to worry about sneaking through the GIUK gap to position military assets off of the Atlantic seaboard, as they did during the Cold War, to threaten the United States.

China

China has increased its engagement in the Arctic to pursue economic opportunity, take advantage of the Northern Sea Route, and enhance its scientific and research activities. China understands the economic opportunity emerging in a new physical, political, and economic Arctic landscape; investing billions in extracting natural resources from Russia's Yamal Peninsula, and surveying for minerals in Greenland, for example.

Since joining the Arctic Council as an observer in 2013, China has announced the development of a polar route as one part of its Belt and Road Initiative (BRI) that includes Russia's Northern Sea Route. China is employing its well-known BRI tools, establishing bilateral cooperative agreements with Arctic countries and offering investments in transportation and communication networks across the Nordic states.

China is expanding its Arctic research stations, to include facilities established in 2013 on the Svalbard archipelago, to an overseas satellite receiving station created in Norway in 2016 , to the China-Iceland Arctic Science Observatory in Kárhól, Iceland. It has also increased its icebreaker capacity, launching its second icebreaker in 2018 with plans to expand its fleet in the near future.

Some experts believe that China has designs to be a norm setter, testing maritime security, scientific parameters, and diplomatic allowances.[11] China wants to develop new guidelines for areas in which it has interests, from investment to navigation, from research to natural resource development. How much of a hard security presence this will entail is unknown, but Chinese actions point to a realization that it must be militarily present to play the long game in the Arctic.

The West

By 2017, NATO began to hedge its perceived risks emanating from Russia. It changed a portion of its command structure to create Joint Forces Command (JFC) Norfolk (an operational-level NATO Headquarters to protect the Atlantic sea lanes) and it reactivated the U.S. Second Fleet, now tasked with responsibility for the European Arctic. In 2017, the U.S. Marine Corps began a regular deployment to Norway to participate in cold weather exercises. In 2018, NATO nations demonstrated their capacity for action in the Arctic by staging one of the largest exercises off the coast of Norway. Named *Trident Juncture*, the effort included 50,000 participants from 31 nations and spanned a broad geographic area to include the North Atlantic and Baltic Seas.

In 2019, the U.S. Department of Defense (DoD) released a new, more robust Arctic strategy in line with the Great Power competition theme of the Trump Administration. The strategy document addressed the Arctic in the opening:[12]

> *"DoD's desired end-state for the Arctic is a secure and stable region in which U.S. national security interests are safeguarded, the U.S. homeland is defended, and nations work cooperatively to address*

shared challenges. . . . DoD must be able to quickly identify threats in the Arctic, respond promptly and effectively to those threats, and shape the security environment to mitigate the prospect of those threats in the future."

To reach this end state, the strategy laid out objectives for DoD, the first of which was to defend the homeland by preparing to defend U.S. sovereignty in the Arctic, including the northern approaches to the United States. Two additional objectives were to "take appropriate actions in the Arctic as part of maintaining favorable balances of power in the Indo-Pacific and Europe" (a nod to the Arctic's role in the Great Power competition with Russia and China), and to ensure access to the Arctic "for legitimate civilian, commercial, and military purposes." Alaska is the base for pursuing many of these goals and objectives as advanced F-35 aircraft are deployed in Fairbanks and additional ballistic missile interceptor missiles are installed at Fort Greeley, adjacent to the community of Delta Junction.

The Nature of Arctic Competition Today

Five factors have led to the increase in military competition in the Arctic.

- **The Arctic is increasingly attractive for economic activity**. Climate change is opening previously frozen passages to global supply chains. Improved technology and the rapid melting of Arctic ice (on land and sea) combine to make access to Arctic resources potentially easier and more economical. Estimated energy and mineral reserves in the region are vast, and the resulting economic potential for the Arctic states (especially for Russia) is enormous.
- **Under these conditions, Arctic nations need to secure their territory and sovereignty in the Arctic.** State boundaries are mostly clear, but there are disputes on the international status of the Northwest Passage and the Northern Sea Route. Russia is testing Norway's position that the shelf

around the Svalbard archipelago is Norwegian sovereign territory. Canada, Denmark, Norway, and Russia also have competing claims to the seabed under the Arctic Ocean.

- **With the reversal of decades of nuclear strategic arms control agreements, a great deal of the predictability of the strategic nuclear environment is at risk.** The Arctic as an avenue of approach for nuclear weapons for both Russia and the United States becomes more worrisome as arms control agreements expire or are breached and strategic stability, especially nuclear stability, becomes more fragile.
- **Unconventional technological aspects of warfare, such as cyber and hypersonic weapons, make an increasingly complicated security landscape even more concerning.** Russia has hacked into the security infrastructure of Arctic states, further increasing tensions. This complexity, combined with capacity on all sides for launching covert intelligence operations, sabotaging infrastructure, destabilizing systems, and generally eroding the regional sense of security only heightens mistrust within the Arctic community.
- **Russian and Chinese cooperation in the Arctic promise to complicate relations within the Arctic community.** While not an Arctic nation, China believes the melting Arctic ice presents investment opportunity to work with Russia to exploit Arctic mineral and energy assets in order to develop the Chinese economy. The two nations cooperate militarily, including the Russia-based Tsentr-2019 exercise and periodic joint naval and air patrols. However, Russia may also have reservations about allowing China too much influence in the Arctic.

Military Competition and Potential Conflict

Given the ever-increasing nature of military presence and activities in the Arctic, the question remains whether diplomatic relations and international law are adequate to stave off conflict. Since the end of the Cold War, the Arctic states have adopted disputes regarding the seabed under the Arctic Ocean, in delimiting the Barents Sea between Norway and Russia, and determining fisheries quotas among the signatories to the Svalbard Treaty. Several confidence-building mechanisms between the Northern European Arctic states and Russia have fostered cooperation on the environment, sustainable development, and Indigenous rights. Moreover, on softer aspects of security—oil spill response, search and rescue, and scientific cooperation—agreements and working groups led by the Arctic Council have been effective in building confidence.

However, when it comes to hard security, the existing conflict resolution mechanisms are a legacy of the Cold War and early post-Soviet era. These include a "hotline" of communication between NATO and the Russian military commanders, notification of forthcoming exercises among militaries, and the more recent establishment of the Arctic Coast Guard Forum. A nascent attempt to gather heads of the Arctic militaries quickly dissolved after Russia invaded Ukraine in 2014.

None of the broader multilateral institutions have the ambit to address military conflict in the Arctic. The Organization of Security Cooperation in Europe, of which all Arctic states are members, works to foster cooperation among members and offers mediation services to countries in conflict, but it has been ineffective at countering Russian aggression. Russia has stopped complying with the Conventional Forces in Europe treaty that capped deployment of weapons and troops, including the Atlantic Ocean. The European Union has steered away from a direct security role, deferring to NATO. The United Nations is increasingly paralyzed when it comes to hard security issues due to the standoff between the United States and Russia.

Hence, when institutions either break down or fail to evolve to meet a new security dynamic, conflict can get out of hand. For example, it is unclear to Russia and NATO whether the other is signaling deterrence from aggression or signaling reassurance and openness to negotiations. Much of the rebuilding of military capacity in the Arctic is intended to restore a level of deterrence. Yet Russia and NATO are each interpreting the actions of the other as strengthening an offensive capability. This creates a security dilemma, in which military forces, installations, and training are interpreted as a threat that requires equal or greater reaction. This perception could raise the potential that spiraling action and reaction could turn predictable military competition into intended or unintended conflict.

What could happen in the Arctic to trigger military hostilities? The most common worry is miscalculation by one side or the other that hostilities were imminent. An example would be fear in Moscow that a large-scale military exercise near their Northern Fleet bastion was actually cover for an attack. Another example would be if NATO intelligence or GPS satellites—critical for stability in the Arctic—were jammed as part of a Russian exercise, particularly if conducted in concert with a cyber exercise. Allies may miscalculate that such moves are a prelude to attack and launch a preemptive strike.

Another potential trigger would be a small event in the Arctic that spirals out of control. An example would be if during an air intercept there is an accidental shoot down of, or collision with aircraft from the other side. This could also happen between ships if they maneuver too close and collide. There is a greater potential for this type of event to occur given the number of unsafe aircraft intercepts and unprofessional harassment of naval vessels by the Russians in the Arctic.[13] If not managed quickly by the nations involved, mistakes may be made in the hours after such an event, leading to possible retaliation that can spiral into a larger crisis.

Incidents of civilian activity have also escalated into military conflict. As climate change shifts fisheries, spurs oil and gas development offshore, and enables increased shipping, dispute resolution will be tested. Countries may try to use their militaries to resolve these disputes, like those in the Barents Sea between Russia and Norway. Military exercises could also come into contact with merchant vessels and cause an accident, which could be misconstrued as an attack.[14]

Non-kinetic conflict between militaries is also increasingly part of the Arctic landscape (cyber, information, electronic, command and control, and spectrum warfare). As Arctic nations increase their military presence in the Arctic and exercises bring military activities closer to sensitive areas, the ability to discern intent is further complicated.

Finally, if general hostilities broke out between Russians and the West outside of the Arctic, the Arctic would not be immune, given the critical communications, intelligence sensors, missile defense sites, and its strategic geographic location. While in this case, the trigger would not necessarily be in the Arctic, the tragedy of warfare between the West and Russia would be keenly felt there.

The Path Forward

Several potential measures could ensure that competition does not get out of hand and result in conflict:

- **Define the threat.** It is important to understand how much of any Arctic nation's military presence is defensive versus offensive. The United States should consider alternative explanations and not simply assume Russia's Arctic military buildup is a strictly offensive measure. Which aspects are meant to bolster territory that is increasingly exposed, underpopulated, and lacking in options for development? Which aspects are meant to secure a sea route in harsh terrain for international shipping through the Northern Sea Route?
- **Focus on deterrence.** Part of deterrence is demonstrating capability and intent to oppose a threat. NATO sends that message clearly to Russia and China through building Arctic capability, domain awareness or monitoring, physical presence, and exercises. However, it is vital that deterrence not be perceived by the other side as preparation for attack. For instance, the capabilities and assigned missions of one branch of the military may prove less threatening than others, while achieving the same strategic effect. Additionally, some capabilities or missions may be better suited for fostering a climate of peaceful cooperation than others. For example, using drones or other technology may be less provocative than warships for monitoring activities in seaways.

- **Build trust.** Arctic competitors also need each another in the harsh terrain for search and rescue and other emergencies. The Russians and the Americans should negotiate an "Incidents at Sea" (INCSEA) agreement for the Arctic, detailing rules of the road for conduct for anyone operating in the Arctic region. Confidence-building measures such as annual consultations, snap inspections, and observers would ensure that there are no surprises.
- **Minimize risk.** The Arctic Security Forces Roundtable ended after the 2014 Western sanctions on Russia. The roundtable should be restarted so that Arctic states can agree to a convention on forces and define the parameters on use of force in the region, as well as establish a conflict resolution mechanism.
- **Enhance alliances.** A trans-Atlantic approach to the Arctic with our European allies should be coordinated and strengthened in juxtaposition to an emerging alliance between Russia and China. This alliance should support enhanced cooperation between European allies and Russia, which have common interests in enhancing economic development while not allowing China to dominate critical sectors.

It is critical to manage competition and reduce the likelihood of conflict in the Arctic through strong deterrence, unambiguous communications about intent, and confidence-building measures.

The Arctic is part of a global geopolitical competition and is not immune to what happens elsewhere. The resilience of Arctic cooperation is being tested as competition increases. Should the U.S. military posture in the Arctic weaken, or should the West fail to enhance institutions and mechanisms that promote stability in the region, then Russia and China may view this as an opportunity to strengthen their positions.

If not carefully managed, competition could escalate into conflict. Efforts to build deterrence could be miscalculated as offensive in nature and answered as such. Indeed, in 2018, Russian Defense Minister Sergey Shoigu announced that competition in the Arctic could lead to potential conflict.[15] As the United States and other Arctic states consider future military strategies and investments to increase deterrence and defense in the Arctic, it is paramount that efforts be made to avoid miscalculation and surprise by either side. Arctic competition is here to stay, but that does not mean conflict is inevitable.

"All statements of fact, analysis, or opinion are the author's, and do not reflect the official policy or position of the National Intelligence University, Department of Defense or any of its components, or the US government."

Russia, Arctic Ocean, July 14 2016 icebreaker with a nuclear power plant of Yamal in the ice at the time of posting of the convoy through the ice field the Northern sea route. *Editorial credit*: knyazev vasily / Shutterstock.com

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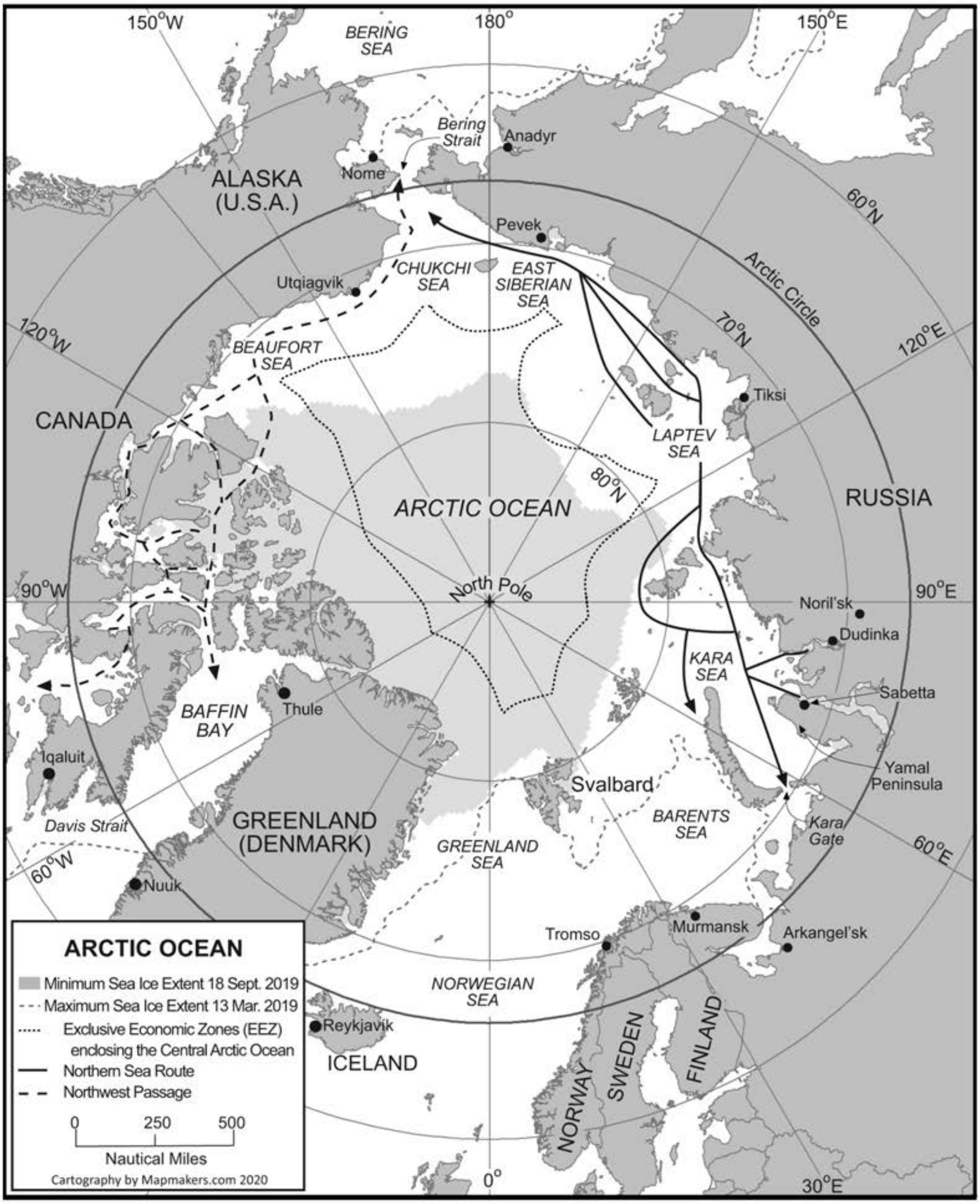
ARCTIC OCEAN
Minimum Sea Ice Extent 18 Sept. 2019
Maximum Sea Ice Extent 13 Mar. 2019
Exclusive Economic Zones (EEZ) enclosing the Central Arctic Ocean
Northern Sea Route
Northwest Passage
0
250
500
Nautical Miles
Cartography by Mapmakers.com 2020
150°W
180°
150°E
BERING SEA
Bering Strait
Anadyr
Nome
ALASKA (U.S.A.)
Pevek
60°N
Arctic Circle
Utqiagvik
CHUKCHI SEA
EAST SIBERIAN SEA
70°N
120°W
120°E
BEAUFORT SEA
Tiksi
CANADA
LAPTEV SEA
80°N
RUSSIA
ARCTIC OCEAN
North Pole
90°W
90°E
Noril'sk
Dudinka
KARA SEA
Sabetta
BAFFIN BAY
Thule
Iqaluit
Svalbard
Yamal Peninsula
BARENTS SEA
Kara Gate
Davis Strait
GREENLAND (DENMARK)
GREENLAND SEA
60°E
60°W
Nuuk
Murmansk
Tromso
Arkangel'sk
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