CLIMATE CHANGE AND THE ARCTIC: WHAT CAN THE U.S. DO TO ADAPT?

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Climate Change and the Arctic: What can the United States do to adapt, while counterbalancing Russia in the region?

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Executive Summary

The Arctic is moving rapidly from an area of cooperation to one of competition. Permafrost melt and receding sea ice is negatively impacting existing infrastructure and future planning for the United States in the Arctic, with the actions of other Arctic and self-styled "near-Arctic" nations exacerbating the need for timeliness in response from U.S. policymakers. Not only is the Arctic experiencing temperature changes two to three times the global average due to climate change, according to the National Oceanic and Atmospheric Administration, but it is also the area where the United States is geographically closest to Russia, given the proximity of Alaska to Russian territory. As the Kremlin has engaged in re-militarization of Cold War-era bases in the Arctic in recent years, and is currently engaging in an invasion of Ukraine, it is not unreasonable that the Arctic could become the next arena for Russian revisionism. This would suggest that to protect its interests in the region, the United States is likely to have to contend with threats from both political and natural sources. Currently, the United States is not in a position of strength compared to other Arctic nations and allies in the region. Although it may be too late to fully address the impact that climate change will have on U.S. interests in the region, there are steps that policymakers could take at this stage to mitigate possible threats. Potential actions include strengthening infrastructure in Alaska to ensure energy security and military readiness, increasing the numbers of ice capable vessels available to the United States Coast Guard, and increasing NATO agility in the region.

Introduction

The United States is falling short on adapting to climate change in the Arctic, which will have implications for U.S. military preparedness in the region, critical infrastructure, and interests in environmental and humanitarian issues. Since the purchase of Alaska in 1867, the United States has had a sovereign interest in the Arctic. Even though this has been an asset for the United States, in terms of access to natural resources, it also introduces a specific set of challenges due to geopolitics and climate change. Over the last fifty years, the Arctic has been disproportionately impacted by global temperature changes. For the United States to maintain a position of strength in the region, the administration needs to approach the issue of climate change in the Arctic holistically. Long-term plans are currently insufficient to address the rapidly changing environment, and elements of the Department of Defense are currently not meeting previous adaptation goals under their own admission. It is only by pursuing interdisciplinary mitigation

[1] *The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes*

strategies that cross the disciplines of science, defense, and law, that the United States can ready itself for the inevitable changes that the rest of the century will bring to Alaska and the Arctic at large.

In order to explore these issues, this paper will outline the areas that the United States is falling short in the Arctic and provide recommendations for U.S. policymakers. Key areas of consideration include the need to mitigate the impacts of permafrost melt and sea ice melt caused by rising global temperatures, with the following recommendations:

- Preventing U.S. readiness in the Arctic from crumbling
    - Department of Defense assets are not sufficiently protected from impending infrastructure challenges, especially in light of Russia's steps towards remilitarization. Greater attention must be given to future-proofing current assets and creating more robust future infrastructure.
- Building the Arctic fleet of the future
    - U.S. naval assets compare poorly to Russian Arctic-specific assets. A lack of icebreaking capability and delays in new vessels will require innovation to meet current demands, like a shared ice breaker or leasing scheme with Canada to alleviate pressure on the United States Coast Guard.
- Moving towards a more agile NATO
    - Exercises like COLD RESPONSE 2022 are a great start, but NATO is lagging behind Russia's preparedness in the region. Without more investment from NATO, the potential for Russian disruption in the Arctic grows more credible.
- Upholding international law and defending U.S. claims in the Arctic
    - Ratification of the United Nations (UN) Convention on the Law of the Sea offers the United States an opportunity to better protect its legal position in the Arctic.
- Cementing infrastructure and protecting energy resources
    - Melting permafrost will continue to cause significant infrastructure problems. Localized remedies like thermosyphons will shore up infrastructure for now but cannot provide a long-term solution given the scale of permafrost impact across U.S. territory in Alaska.
- Bracing for change: meeting community needs
    - When infrastructure improvements are not feasible, relocation may be the only option for communities vulnerable to climate change impacts.
- Collaboration as the antidote for competition
    - Building capacity in knowledge sharing forums like the Arctic Council and Arctic Coast Guard Forum deepens relationship with allies in the region and enables the United States to benefit from innovation developed in other Arctic nations like Sweden.

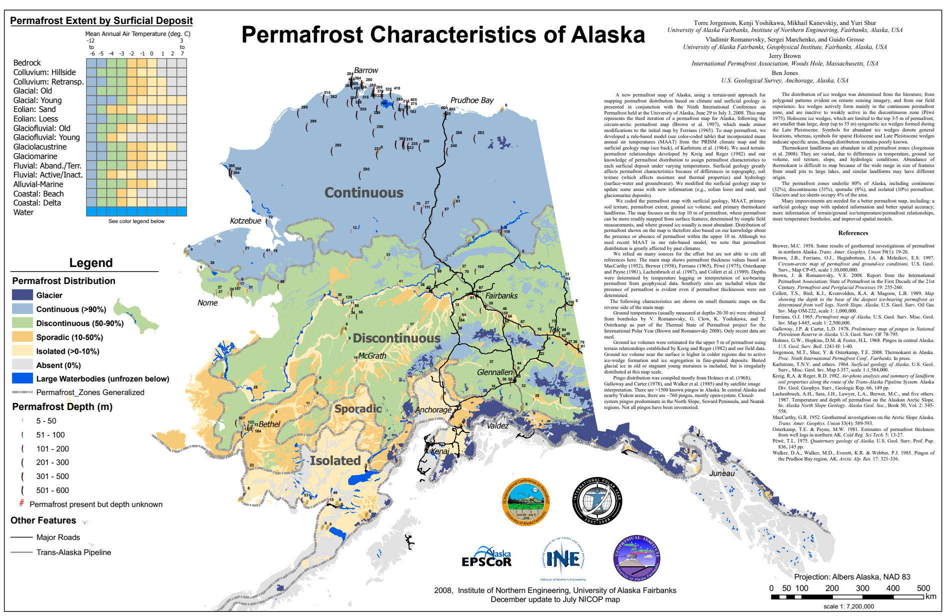
Climate change challenges in the Arctic

The polar climates are serving as a canary in a coalmine regarding the impacts of climate change. According to data collected by the Intergovernmental Panel on Climate Change (IPCC) and the National Oceanic and Atmospheric Administration (NOAA), temperature change in the Arctic is between two to three times higher than the global average.[2] This accelerated temperature rise is exacerbating climate challenges that are unique to the Arctic, such as the melting of permafrost, and the increased melt of sea ice.

Sea ice melt may have some strategic advantages for the ease of navigation in the region, or the access to resources. However, according to modelling by Los Alamos National Laboratory, regardless of the model used, the sea ice likely to melt in the coming decades is significant and will have far-reaching implications.[3] From rising sea levels to the inability to conceal submarines, to conservation and habitat concerns, reduced sea ice poses significant challenges for the United States and other actors in the region.

Permafrost melt is of particular concern for the United States. Alaska – which is partly located inside the Arctic Circle – is approximately 80 percent permafrost (as seen in Figure 1 below, courtesy of research from the University of Alaska Fairbanks).

Figure 1. Permafrost Characteristics of Alaska[4]



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2 M. -L. Timmermans and Z. Labe, "NOAA Arctic Report Card 2021: Sea Surface Temperature," 2021, https://www.arctic.noaa.gov/Report-Card/Report-Card-2021/ArtMID/8022/ArticleID/944/Sea-Surface-Temperature.; IPCC Core Writing Team, "Climate Change 2022 Impacts, Adaptation and Vulnerability - Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change" (Geneva, Switzerland: IPCC, March 2022).

3 Gennaro D'Angelo et al., "Sea Ice Evolution along the Northern Sea Route and Implications for Trans-Arctic Shipping from 2021 through 2060," November 18, 2021, https://doi.org/10.2172/1832347.

4 Torre Jorgenson et al., *Permafrost Characteristics of Alaska* (Institute of Northern Engineering, University of Alaska Fairbanks, December 2008), https://www.epa.gov/sites/default/files/2017-09/documents/ak-state_attachment_2017-06-19.pdf.

This means that as temperatures rise, and permafrost thaws, much of the state is likely to see impacts to infrastructure and human security issues, such as sanitation. Permafrost slump, where melting permafrost causes sagging in the ground, is a significant area of concern and may occur more frequently across the state with increased rates of melt. As slumps occur, infrastructure can be rapidly degraded with little warning. This issue is currently affecting a swath of U.S. activities in the region, from the oil and gas industry to the Department of Defense (DoD).

Areas where the United States is falling short

In seeking to create a holistic picture of where the United States is positioned in the Arctic, and how it is likely to weather the changes that the twenty-first century will bring in the region, an evaluation of shortcomings is an essential part of that process. Although there are areas in which the U.S. lack of preparedness remains solely a domestic problem, given proximity to Russia a comparison between U.S. and Russian efforts in the region is instructive of the policy solutions required. Examining Chinese activity in the region under the Polar Silk Road Initiative provides an area for further research but focusing on substantive Russian efforts is more helpful in determining current U.S. vulnerabilities in the region.

The first area the United States is falling short in relates to legal jurisdiction over maritime areas of the Arctic. While the capabilities of the U.S. Navy are well-documented, and in recent years there has been a pivot to recognize the vital role of the U.S. DoD in protection of U.S. interests in the Arctic – the recommissioning of the Navy's 2nd fleet being one such example[5] - there are some gaps regarding legal authority for certain operations outside U.S. domestic waters. Freedom of navigation operations conducted by the U.S. Navy have had varying degrees of success elsewhere in the world,[6] but the interests of the United States in the Arctic will require greater legal protections, particularly as U.S. neighbors in the region, such as Russia, seek to utilize the full force of international law in protecting their regional interests. As the Arctic opens up, the United States will have to be more vigilant in protecting its territorial waters and exclusive economic zones.

The most obvious example of this pertains to the U.S. stance on the United Nations Convention on the Law of the Seas (UNCLOS). The United States was party to the negotiations preceding this treaty, and is a signatory but has not ratified it, unlike its Arctic neighbors. In contrast, Russia has not only ratified the convention, but has made several attempts to utilize mechanisms within the convention to further Moscow's revisionist objectives. In March 2021, Russia amended a submitted claim to the Commission of UNCLOS to extend its continental shelf claim in the Arctic, which not only impinges on the continental shelf claims of its European neighbors in the Arctic but would also potentially give Moscow control over a greater share of natural resource in the

[5] Christopher Woody, "The US Navy's Newest Fleet Is Keeping an Eye on the North Atlantic with a First-of-Its-Kind Deployment," Business Insider, May 9, 2022, https://www.businessinsider.com/us-navy-2nd-fleet-surge-deployment-north-atlantic-russia-tension-2022-5.
[6] Abhijnan Rej, "US Destroyer Conducts FONOP in South China Sea – The Diplomat," February 6, 2021, https://thediplomat.com/2021/02/us-destroyer-conducts-fonop-in-south-china-sea/.

region.[7] Notably, this claim is yet to be adjudicated, but a Russian willingness to utilize UNLCOS to further a domestic agenda may also bleed into other areas of the Arctic, such as the status of the partially-ice covered shipping routes Russia claims are in domestic waters.

As the sea ice continues to melt, this may be a significant issue for the United States. Melting sea ice opens up the opportunity to extract more natural resources currently inaccessible or impractical to access. It also will enable more consistent navigation through the Northern Sea Route and the Northwest Passage.[8] The increased usage of the Northern Sea Route is of particular interest for Russia, as it would enable increased trade from the Arctic Zone of the Russian Federation (AZRF). Ratifying UNCLOS would give the United States more standing to push back on these types of aggressive behaviors under provisions such as Article 233 on straits for internal navigation and Article 234 on ice covered waters.

There has been some hesitancy from factions in U.S. Congress to ratify UNCLOS. The most compelling argument not to ratify concerns royalties, which would be collected from states party to the Convention by the International Seabed Authority and redistributed to developing and landlocked nations. It is important to note that these royalties are already collected absent the U.S. ratification of the treaty, as a part of the proceeds from the collection and sale of natural resources go to the U.S. Department of the Treasury. But instead of a portion being redistributed, the entirety is collected by the U.S. Department of the Treasury. Other analysis suggests the possibility of lawsuits brought against the United States on grounds of climate change,[9] but the actual likelihood of claims being filed – or a substantive judgement against the United States being issued or adhered to – is low.

The role of NATO is intrinsically tied to international cooperation and governance in the region. In the changing security environment, there are several unique challenges and opportunities that are presented for the United States and its NATO allies in terms of preparedness and operational agility. On one hand, NATO is exhibiting a strong and cohesive front in the region; with the formal invitation of June 29, 2022, for Finland and Sweden to join the alliance,[10] Russia would become the only non-NATO Arctic nation. This is likely to further enflame potential security tensions in the region and exacerbate misunderstandings that could arise from training exercises. Additionally, there is evidence that in light of the international community's response to the Russian invasion of Ukraine, Russia feels threatened in the region. In March, a Russian MP demanded that the United States return Alaska to form part of the AZRF.[11] This is particularly concerning and is a stark reminder that the United States and Russia are separated by a mere

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[7] "Continental Shelf - Submission to the Commission by the Russian Federation," accessed May 9, 2022, https://www.un.org/depts/los/clcs_new/submissions_files/submission_rus_rev1.htm.

[8] Gennaro D'Angelo et al., "Sea Ice Evolution along the Northern Sea Route and Implications for Trans-Arctic Shipping from 2021 through 2060," November 18, 2021, https://doi.org/10.2172/1832347.

[9] Steven Groves, "Should the U.S. Ratify the U.N. Convention on the Law of the Sea?," The Heritage Foundation, June 13, 2022, https://www.heritage.org/global-politics/commentary/should-the-us-ratify-the-un-convention-the-law-the-sea.

[10] The Associated Press, "Video: NATO Formally Offers Sweden and Finland Membership to the Alliance," *The New York Times*, June 29, 2022, sec. World, https://www.nytimes.com/video/world/europe/100000008422081/nato-finland-sweden.html.

[11] Darragh Roche, "Alaska Gov. Reacts to Hearing Russia Wants It Back: 'Good Luck with That,'" Newsweek, March 16, 2022, https://www.newsweek.com/alaska-gov-reacts-russia-wants-back-good-luck-ukraine-1688431.

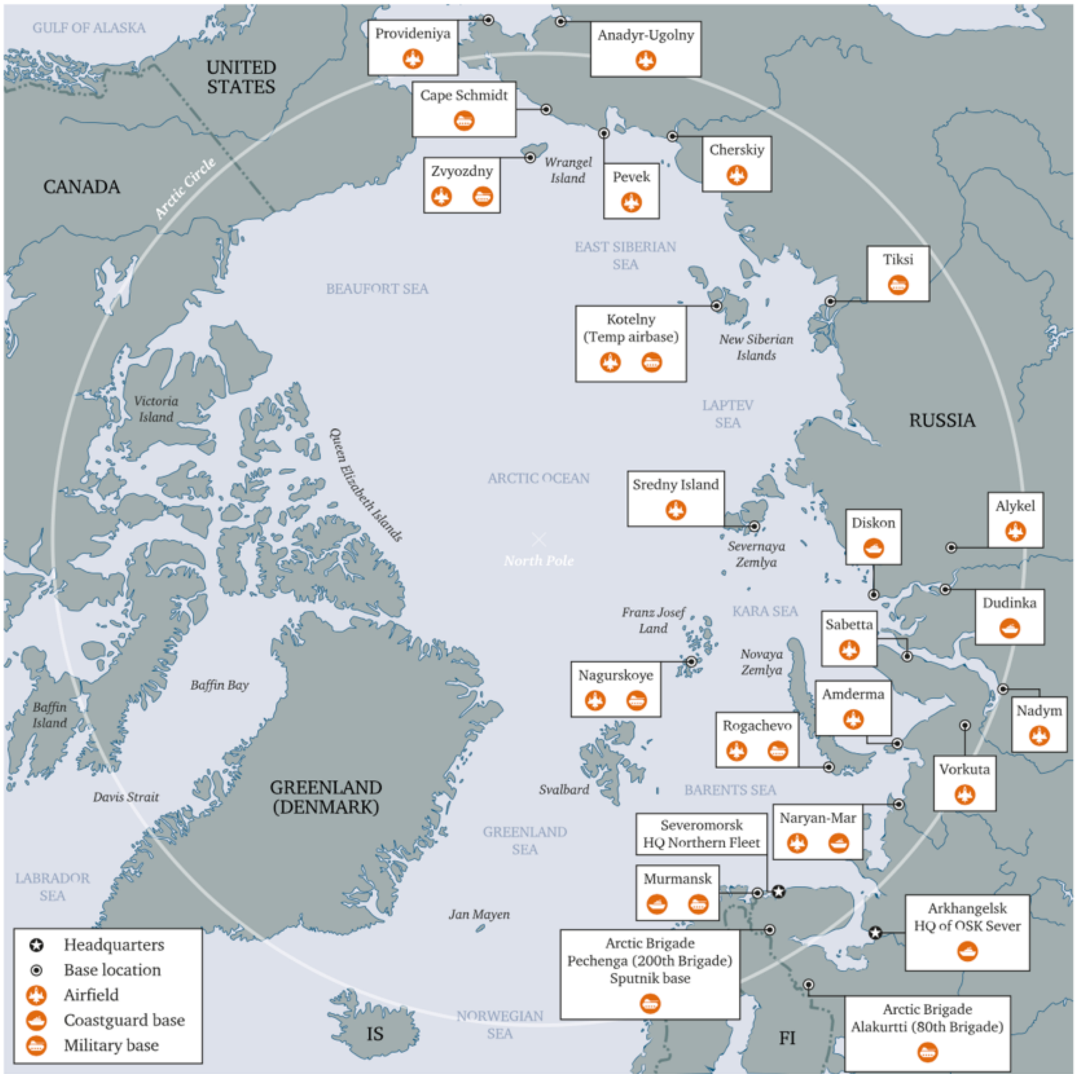
sixty-five miles across the Bering Strait. Russia is also doubtless aware that the increasing sea ice melt makes it much more difficult to leverage the camouflage of the ice. Historically, substantial sea ice coverage enables the movement of submarines to be obscured; a reduction in sea ice will enable clearer imaging and tracking. This is more likely to impact the Russian sub-surface ballistic nuclear (SSBN) assets – a pivotal piece of Russian sea-based deterrent in the region.

NATO presence is fairly robust in the Arctic region, with a variety of shared assets and regularly scheduled training exercises, such as COLD RESPONSE.[12] This training concluded earlier in 2022 with participation from approximately 30,000 troops from twenty-seven countries. However, the exercise took several years to plan and deploy – in part due to the COVID-19 pandemic. Other current NATO ventures in the region include airspace protection through the temporary deployment of Italian fighter jets to dissuade Russian airspace encroachment.[13]

These activities suggest a renewed interest among NATO members to focus on threats in the north, but they do not match the extent to which Russian military activity has ramped in the region throughout the twenty-first century. Russia has repeatedly returned to a posture of greater preparation in the region, from increased exercises in terms of both complexity and scope – the Zapad 2021 exercises are just one example[14] – to permanent bases. In data collated by Chatham House, it is evident that Russia has invested significantly in their military capabilities in the AZRF.[15] This includes the reopening and return to operational capability of a slew of bases, as well as increased mobile military assets in the region. These bases are predominantly Cold War-era but are now modernized and equipped to face challenges in the region from the United States and other allied Arctic nations. The Chatham House graphic below (Figure 2) details 24 Russian bases. For comparison, the United States currently maintains 6 U.S. bases in Alaska, and one in Greenland.

[12] NATO, "Exercise Cold Response 2022 – NATO and Partner Forces Face the Freeze in Norway," NATO, accessed June 2, 2022, https://www.nato.int/cps/en/natohq/news_192351.htm.
[13] Allied Air Command Public Affairs Office, "Italy Supports NATO Collective Efforts with F-35A Deployment to Iceland," ac.nato.int, April 22, 2022, https://ac.nato.int/archive/2022/ITA_ISL_announcement.aspx.
[14] Thomas Nilsen, "Fishermen Troubled by Escalating Russian War Games," The Independent Barents Observer, September 9, 2021, https://thebarentsobserver.com/en/security/2021/09/fishermen-troubled-escalating-russian-war-games.
[15] Mathieu Boulègue, "Russia's Military Posture in the Arctic: Managing Hard Power in a 'Low Tension' Environment" (Chatham House, The Royal Institute of International Affairs, June 2019), https://www.chathamhouse.org/sites/default/files/2019-06-28-Russia-Military-Arctic_0.pdf.

Figure 2. Russian Bases in the Arctic[16]



For the DoD this increased Russian military presence in the Arctic should cause alarm, especially when examined in light of DoD assets in the region. The recommissioning of the Naval 2nd fleet goes some way to mitigate the impact of Russian activity in the region – or at least provide more intelligence on those activities – but there are clear gaps in U.S. assets and competencies. The U.S. Navy has no operational ice breaking vessels, relying instead on the United States Coast Guard for these capabilities. Given the data on melting and receding sea ice mentioned above,[17] continued concern about ice breaking capabilities may seem like a secondary priority, or a divestment of funds for capabilities that will soon become obsolete. However, most projections

[16] Mathieu Boulègue, "Russia's Military Posture in the Arctic: Managing Hard Power in a 'Low Tension' Environment" (Chatham House, The Royal Institute of International Affairs, June 2019), https://www.chathamhouse.org/sites/default/files/2019-06-28-Russia-Military-Arctic_0.pdf.

[17] Gennaro D'Angelo et al., "Sea Ice Evolution along the Northern Sea Route and Implications for Trans-Arctic Shipping from 2021 through 2060," November 18, 2021, https://doi.org/10.2172/1832347.

agree that there will be some level of sea ice cover for the next few decades; a period of time in which it is imperative that the United States is able to fully protect and defend its waters.

By contrast, Russia has a robust fleet of ice breaking vessels,[18] and the capability to invest in further ice breakers in the first half of the century. Even China, with two functional ice breaking vessels – albeit for primarily scientific reasons – is better positioned than the United States regarding navigation in ice-covered waters. This poses a significant problem, considering China's use of dual-use vessels elsewhere in the world. If a Chinese maritime militia as has been seen in the South China Sea is deployed in the Arctic, it is likely that there could be impingement on U.S. territorial waters and fishing stock. Currently, the United States would not be sufficiently prepared to adequately defend such a risk, particularly if a violation occurred in partially ice-covered waters.

Although DoD has invested in some infrastructure improvement and increased climate modeling, the efforts to mitigate some of the more specific climate impacts facing assets in the Arctic region have not been fully realized. Long-term plans are currently insufficient to address the rapidly changing environment, and elements of the DoD are currently not meeting previous adaptation goals. The Army, for example, is already falling behind on resilience plans related to Alaskan bases.[19] Tools have been created that utilize the most accurate data currently available, such as the Regional Sea Level Scenarios for Coastal Risk Management that maps and projects anticipated sea level rise on DoD assets worldwide,[20] but the gap between modelling and adaptation to meet modelling predictions is lagging.

Where adaptation processes have been initiated, DoD is spending significant funds to mitigate a fraction of future changes. Incremental measures, such as those detailed at Eielson Air Force Base below,[21] are mostly reactive in nature – leading to a piecemeal approach to catch up to the rate of change. These niche adaptation challenges are proving expensive. In data obtained by the Center for Investigative Journalism at Howard University, military planners requested over $1 billion between 2015 – 2020 to keep three Alaskan military bases operational.[22] Not all of these funds were directed towards climate mitigation, but for one base – Eielson Air Force Base – $164 million was utilized between 2017 – 2020 for construction and repairs to infrastructure caused by permafrost. Perhaps most troubling is the need for thermosyphon projects to ensure

[18] United States Coast Guard, Office of Waterways and Ocean Policy, *Major Icebreakers of the World*, May 1, 2017, https://www.dco.uscg.mil/Portals/9/DCO%20Documents/Office%20of%20Waterways%20and%20Ocean%20Policy/20170501%20major%20icebreaker%20chart.pdf?ver=2017-06-08-091723-907.
[19] Inspector General U.S. Department of Defense, (U) Evaluation of the Department of Defense's Efforts to Address the Climate Resilience of U.S. Military Installations in the Arctic and Sub-Arctic, April 13, 2022, https://media.defense.gov/2022/Apr/15/2002977604/-1/-1/1/DODIG-2022-083.PDF.
[20] J.A. Hall et al., "Regional Sea Level Scenarios for Coastal Risk Management: Managing the Uncertainty of Future Sea Level Change and Extreme Water Levels for Department of Defense Coastal Sites Worldwide" (U.S. Department of Defense, Strategic Environmental Research and Development Program, 2016), https://drsl.serdp-estcp.org/Docs/CARSWG_SLR.pdf.
[21] Sara Karlovitch et al., "Global Warming Is Having a Costly, and Dangerous, Impact on Key Military Bases in Alaska," The Seattle Times, August 9, 2020, https://www.seattletimes.com/seattle-news/environment/impact-of-melting-permafrost-on-three-military-installations-in-alaska/.
[22] Sara Karlovitch et al., "Global Warming Is Having a Costly, and Dangerous, Impact on Key Military Bases in Alaska," The Seattle Times, August 9, 2020, https://www.seattletimes.com/seattle-news/environment/impact-of-melting-permafrost-on-three-military-installations-in-alaska/.

structural integrity and stability for munitions bunkers, which were experiencing sinking due to permafrost slump. Thermosyphons provide a cooling effect to offer stabilization to a temperature-sensitive area, such as permafrost, by relocating heat or diffusing it into the atmosphere. An example of the practical outworking of this is detailed below in Figure 3. As temperatures continue to rise, costs for these mitigation projects are only likely to increase, making attainment of a sufficient level of readiness more difficult. In the long term, this is likely to cost the DoD more in terms of budget share than creating future-proof assets initially.

Figure 3. Thermosyphons in action at Eielson Air Force Base[23]

Munition bunkers at Eielson Air Force Base, Alaska, are built on a flat-loop thermosyphon system to stabilize the permafrost beneath infrastructure.

However, one significant hurdle to cross for future-proofing assets concerns weatherization and infrastructure. This impacts not only the DoD, but assets belonging to the Department of Energy and the civilian sector as well. The private sector has attempted to take some steps towards resilience-building in infrastructure, with the Trans-Alaska Pipeline System (TAPS) offering a salient example. The TAPS traverses the length of the state of Alaska, facilitating the transportation of oil from Prudhoe Bay in the Beaufort Sea to Valdez on the Gulf of Alaska, and has transported over 18 billion barrels of crude oil to date. Daily, this equates to approximately 480,000 barrels.[24] For context, there are almost 4,000 miles of oil and gas pipelines tracking through the state of Alaska; the TAPS alone has had 18 spills in the last two decades, with each

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[23] Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment), "Highlights and Examples for the Department of Defense Climate Adaptation Plan," 2021, https://media.defense.gov/2021/Nov/03/2002886171/-1/-1/0/HIGHLIGHTS-AND-EXAMPLES-FOR-DOD-CLIMATE-ADAPTATION-PLAN.PDF, p.17.

[24] "Trans Alaska Pipeline System (TAPS)," Alyeska Pipeline, accessed June 1, 2022, https://www.alyeska-pipe.com/trans-alaska-pipeline-system-taps-overview/.

individual spill resulting in a loss of between less than one barrel and 6,800 barrels of oil. Not all of these spills are directly due to permafrost melt, but it is a causal factor. In total, the TAPS has spilled 9,784 barrels of oil to date, which has resulted in $52.7 million in damages and costs.[25]

Although some permafrost melt modelling was attempted as part of the pipeline construction process in the 1970s, these estimates proved wildly inaccurate given the rate of temperature change and permafrost melt in Alaska. Subsequently, the initial temperature mitigation – which included the use of thermosyphons as a mechanism to channel heat from the pipeline away from the permafrost – has been unable to prevent the pipeline from slumping as permafrost underneath it thaws. To remedy localized slumps, additional thermosyphons have been placed along the pipeline. The aim is to divert heat from the pipeline away from the permafrost beneath and diffuse it into the surrounding environment.[26] However, while this solution mitigates the immediate acute permafrost melt, the diffusion of heat from the pipeline has implications for the atmospheric temperature rise in the region, contributing to the larger problem the thermosyphon is attempting to mitigate.

The problem with infrastructure stabilization measures, such as the additional thermosyphons on the Trans-Alaska Pipeline, is that they rely on the data currently available to address increasingly complex engineering problems. When those calculations are inaccurate, or reality rapidly outpaces the modeling, the implications are catastrophic. For example, permafrost melt exacerbated by wildfires led to the collapse of a fuel tank in northern Siberia in June 2020. The ensuing spill dumped 21,000 tons of diesel into the environment, spreading over seven miles and polluting the Ambarnaya River.[27] The efforts to clean up the spill will take a decade according to the estimates of the Russian authorities. But rather than keeping government and private sector responses discrete, Russia has developed a public-private partnership to infuse significant funds into the areas of Siberia most impacted.[28] These funds, due to be divested through 2024, suggest an ambitious and forward-thinking approach to the changing needs in the energy sector and infrastructure of Siberia.

One area connected to the infrastructure problem concerns human security in the region. The Arctic region is home to approximately forty different indigenous groups, many of whom reside in Alaska.[29] Both domestic bodies and intergovernmental bodies are collecting data on the challenges facing these groups, but the scope and speed of response is insufficient to meet the needs documented for the population, which is 50-75 percent indigenous.[30] Investigations by the

[25] David Hasemyer, "Trans-Alaska Pipeline under Threat from Thawing Permafrost," July 14, 2021, https://www.hcn.org/articles/climate-change-trans-alaska-pipeline-under-threat-from-thawing-permafrost.
[26] David Hasemyer, "Trans-Alaska Pipeline under Threat from Thawing Permafrost," July 14, 2021, https://www.hcn.org/articles/climate-change-trans-alaska-pipeline-under-threat-from-thawing-permafrost.
[27] Sankaran Rajendran et al., "Monitoring Oil Spill in Norilsk, Russia Using Satellite Data," *Scientific Reports* 11, no. 1 (December 2021): 3817, https://doi.org/10.1038/s41598-021-83260-7.
[28] Sankaran Rajendran et al., "Monitoring Oil Spill in Norilsk, Russia Using Satellite Data," *Scientific Reports* 11, no. 1 (December 2021): 3817, https://doi.org/10.1038/s41598-021-83260-7.
[29] Shinan Wang, *Indigenous Population in the Arctic* (Nordregio, March 21, 2019), https://nordregio.org/maps/indigenous-population-in-the-arctic/.
[30] Shinan Wang, *Indigenous Population in the Arctic* (Nordregio, March 21, 2019), https://nordregio.org/maps/indigenous-population-in-the-arctic/.

Council on Foreign Relations, for example, demonstrate a lack of ability to meet basic needs in the region. The United States is falling far short now – before the increases in permafrost melt and wildfires – in meeting basic sanitation goals under the United Nations Sustainable Development Goals.[31]

Not only is the United States failing to meet these basic needs, but there is also little traction for communities and settlements that will become uninhabitable in the coming decades. What to do about communities that will no longer be able to sustain life in the region is a significant question, with few long-term options. Resettlement or relocation are options that have been voted on in certain communities like Shishmaref, which is rapidly under threat from rising sea levels.[32] However, even where communities are open to relocation, little progress has been made to facilitate this process.

By comparison, Russia appears to have a better grasp on the future needs of indigenous groups in the AZRF. The Russian Association of Indigenous Peoples of the North (RAIPON) is not only involved in advocating for Russian indigenous groups at an intergovernmental level through mechanisms such as the Arctic Council,[33] but also has direct access to the Duma, enabling a shaping of Russian policy towards the region. This helps to ensure that funds earmarked under the public-private partnership in Siberia will directly address some of the development issues facing communities.

One method to address these issues more holistically is through the Arctic Council and associated cooperation mechanisms, like the Arctic Coast Guard Forum. In many ways, the Arctic Council offers a vital communication lifeline with Russia, especially given a lack of direct military-to-military communication. The Council offers opportunities to collaborate and learn from other Arctic nations, which can only be a benefit to the United States as Arctic nations grapple with similar issues of sea ice and permafrost melt. However, if the latest NATO applications are successful, Russia would become the only non-NATO Arctic nation. This is likely to both increase the necessity of the Council's activities and make cooperation with Russia more difficult.

Currently, Russia holds the Chair of the Arctic Council; a position that rotates every two years. Due to Russia's invasion of Ukraine earlier in 2022, the other members of the Arctic Council suspended all activity in protest. This boycotting of the Council is preventing meaningful communication with Russia on Arctic issues, which impinges essential scientific activity in the region, hampering data collection and communication that would benefit the United States as it ascertains the extent of climate-related changes in the region.

[31] Thad W. Allen, Christine Todd Whitman, and Esther Brimmer, "Arctic Imperatives: Reinforcing U.S. Strategy on America's Fourth Coast," Independent Task Force Report (Council on Foreign Relations, March 2017).

[32] Joint Ocean Commission Initiative, "Arctic Town Votes to Relocate to Avoid Rising Seas," Ocean Action Agenda, March 2017, https://oceanactionagenda.org/story/arctic-town-climate-change/.

[33] "Russian Association of Indigenous Peoples of the North," Arctic Council, last accessed June 16, 2022, https://www.arctic-council.org/about/permanent-participants/raipon/.

Policy Recommendations

Preventing U.S. readiness in the Arctic from crumbling

The DoD has already conducted some modeling to determine how their assets in the region are likely to be impacted by climate change. However, DoD must also pay attention to how Russia has moved in the Arctic over the last decade. Prior to the invasion of Ukraine, the Arctic was one of the key focus areas for the Russian military. According to reporting from Chatham House, a significant number of Russian military bases have either been reopened or rebuilt since 2014.[34]

Given the DoD pivot towards adaptation, there have been some measures taken to try and increase U.S. resilience in the region. The DoD Climate Change Adaptation Plan and tools such as the Regional Sea Level Scenarios for Coastal Risk Management have ensured that some of the more far-reaching impacts of climate change – such as sea level rise – are front of mind for military planners.[35] However at some point, thermosyphon projects like the one at Eielson Air Force Base will be insufficient as the rate of melt will be too great to use thermosyphon systems to underpin what little permafrost remains.

Rather than utilizing just-in-time stabilization techniques, the DoD should conduct a holistic review of all assets that may be impacted by permafrost melt using models and data towards the upper echelon of the risk framework, and plan future-forward infrastructure accordingly. While portions of this data look unimaginable at the current time, historically models have significantly underestimated the extent of permafrost melt. Correcting these errors is prohibitively expensive, and for long-term budgetary concerns, a more risk-averse approach to infrastructure may bring short term financial pain but provide the DoD with assets that are more resilient in the long term. It is likely that with the United States facing continued readiness challenges, Russia will seek and gain advantage in the region.

Building the Arctic fleet of the future

The DoD has substantial water-based assets in the region.[36] The U.S. Navy's 2nd Fleet, in conjunction with the Department of Homeland Security's United States Coast Guard, provide the bulk of these assets, but there are significant gaps. Although the sea ice is melting, it is unlikely to have completely melted in the coming decades. As such, the need for ice breaking vessels is of utmost importance for the U.S. Coast Guard to fulfil all its congressional mandates and ensure the defense of U.S. waters and exclusive economic zones in the region. Congress has approved

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[34] Mathieu Boulègue, "Russia's Military Posture in the Arctic: Managing Hard Power in a 'Low Tension' Environment" (Chatham House, The Royal Institute of International Affairs, June 2019), https://www.chathamhouse.org/sites/default/files/2019-06-28-Russia-Military-Arctic_0.pdf.

[35] Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment), "Highlights and Examples for the Department of Defense Climate Adaptation Plan," 2021, https://media.defense.gov/2021/Nov/03/2002886171/-1/-1/0/HIGHLIGHTS-AND-EXAMPLES-FOR-DOD-CLIMATE-ADAPTATION-PLAN.PDF; J.A. Hall et al., "Regional Sea Level Scenarios for Coastal Risk Management: Managing the Uncertainty of Future Sea Level Change and Extreme Water Levels for Department of Defense Coastal Sites Worldwide" (U.S. Department of Defense, Strategic Environmental Research and Development Program, 2016), https://drsl.serdp-estcp.org/Docs/CARSWG_SLR.pdf.

[36] Christopher Woody, "The US Navy's Newest Fleet Is Keeping an Eye on the North Atlantic with a First-of-Its-Kind Deployment," Business Insider, May 9, 2022, https://www.businessinsider.com/us-navy-2nd-fleet-surge-deployment-north-atlantic-russia-tension-2022-5.

plans to expand U.S. icebreaking capabilities, [37] but these fall far short of U.S. requirements, or current ice-breaking assets in other Arctic states. [38]

Currently, the United States has two operational ice breakers. The first of the new ice breakers for the U.S. Coast Guard has been delayed until at least 2025.[39] By shoring up maritime assets, the United States would be better positioned to defend its territorial waters and economic interests in the region. Due to the extensive delays in procurement, considering leasing an icebreaker from Canada or Finland given their sizeable fleets of varying weight classes may not be out of the question.

Moving towards a more agile NATO

The importance of NATO in the Arctic cannot be underestimated at this juncture. With the formal invitation from NATO for Finland and Sweden to join the alliance, seven of the eight Arctic nations would also be NATO member countries.[40] This may have significant impacts on Russian behavior in the region, as well providing new opportunities and resources for the alliance.

Given these changes in the geopolitical situation of the region, the United States should be vocal in advocating for increased investment in strengthening North American Aerospace Defense Command (NORAD) and NATO capabilities. This could include shared ice-breaking capabilities with allies, or increased exercises in the region. NATO recently held exercise COLD RESPONSE 2022, with significant participation from members and partners.[41] Although successful, this exercise took several years to plan. NATO needs to demonstrate it has the capability for more agile responses in the rapidly changing environment. Agility is needed not only in deployment of troops accustomed to the unique challenges of operating in a Polar environment, but also in the types of infrastructure and assets NATO deploys in the region. Deploying Italian fighter jets to protect airspace is a good example of adapting to meet the increased Russian presence in the region, but this diverts assets away from other forward operating air bases.[42]

Upholding international law and defending U.S. claims in the Arctic

Although this seems surprising as a substantive recommendation in a paper on climate change impacts, the U.S. ratification of the UNCLOS may be one of the best tools to protect U.S. interests in the region and allow for an agile response to climate change in the Arctic. The benefits

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[37] Ronald O'Rourke, "Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress" (Congressional Research Service, February 5, 2020), http://www.akleg.gov/basis/get_documents.asp?session=32&docid=27134.

[38] United States Coast Guard, Office of Waterways and Ocean Policy, Major Icebreakers of the World, May 1, 2017, https://www.dco.uscg.mil/Portals/9/DCO%20Documents/Office%20of%20Waterways%20and%20Ocean%20Policy/20170501%20major%20icebreaker%20chart.pdf?ver=2017-06-08-091723-907.

[39] Melody Schreiber, "The Newest US Icebreaker Now Has a Name, but Construction Is Still Delayed," *ArcticToday* (blog), February 28, 2022, https://www.arctictoday.com/the-newest-us-icebreaker-now-has-a-name-but-construction-is-still-delayed/.

[40] Jackie Northam, "Russia May Become the Only Non-NATO Nation in the Arctic, Sparking Fears of Conflict," *NPR*, May 12, 2022, sec. World, https://www.npr.org/2022/05/12/1098585422/russia-may-become-the-only-non-nato-nation-in-the-arctic-sparking-fears-of-confl.

[41] NATO, "Exercise Cold Response 2022 – NATO and Partner Forces Face the Freeze in Norway," NATO, accessed April 25, 2022, https://www.nato.int/cps/en/natohq/news_192351.htm.

[42] NATO, "NATO on the Map," accessed June 17, 2022, https://www.nato.int/nato-on-the-map/#lat=63.413419&lon=9.36839&zoom=0&lang=en&viewer=gmaps&layer-5&infoBox=38.

outweigh the risks, without intruding on U.S. sovereignty. The United States is a signatory to UNCLOS, but it has not undergone ratification through Congress.[43] This means that the United States may be able to rely on some provisions on UNCLOS that are also found in customary international law but cannot rely on the full measure of UNCLOS or use it to bring claims against potential infringements by other Arctic nations to a designated dispute resolution body.

However, the benefits of ratifying UNCLOS outweigh these risks. The United States has long sought to uphold the rule of law and the international order; ratifying UNCLOS would demonstrate that the United States is keen to uphold these values, particularly in the face of Russian and Chinese revisionism. While it is true that China has largely ignored rulings against them concerning cases in relation to their activities in the South China Sea, there are still diplomatic implications. Ratification by the United States is likely to be helpful in consensus-building and engaging with greater diplomatic efforts with allies who have at times doubted the U.S. commitment to the maritime interests of allies and partners around the globe.

Cementing infrastructure and protecting energy resources

As mentioned above, the melting of permafrost can cause sinkage or slump to occur. Because this is happening to the surface of the earth, and in the soil, this can create significant slippage, which impacts the infrastructure built on top of it. This instability in infrastructure also impacts other countries in the region, and the results of damage to infrastructure can have truly devastating environmental and economic impacts. A spill akin to the magnitude of the Ambarnaya River diesel spill in Alaska would have unthinkable costs both environmentally but also economically, especially as domestically produced oil and gas remains critical to the global pivot away from Russian energy sources.

The U.S. energy industry is also concerned; the TAPS is already facing the consequences of permafrost slump. It is important to mention that at the time of construction, engineers took into account permafrost modeling that was available at the time, and adjusted their construction plans accordingly. Unfortunately, these models have proved to be wildly inaccurate, and do not account for the rapidity of temperature change and permafrost melt being experienced in Alaska.[44] As a result, a thermosyphon project has been placed north of Fairbanks to stabilize the pipeline by siphoning heat away from the permafrost and into the surrounding atmosphere.[45] This project is necessary to ensure a continued level of structural integrity for the pipeline, but it combats melting permafrost by releasing heat into the atmosphere instead, where it then contributes to air temperature rises, thus exacerbating the problem in the long term.

Not only are there significant environmental considerations when energy infrastructure is not resilient to the changing Arctic climate, but the economic pain is also very real. In an effort to

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[43] "Law of the Sea Convention," *United States Department of State*, accessed May 6, 2022, https://www.state.gov/law-of-the-sea-convention/.

[44] David Hasemyer, "Trans-Alaska Pipeline under Threat from Thawing Permafrost," July 14, 2021, https://www.hcn.org/articles/climate-change-trans-alaska-pipeline-under-threat-from-thawing-permafrost.

[45] State of Alaska Department of Natural Resources, "Analysis and Proposed Decision Trans-Alaska Pipeline Right-of-Way Lease Amendment, ADL 63574 Thermal Improvements at Lost Creek Hill, Pipeline Milepost 392," November 30, 2020, https://aws.state.ak.us/OnlinePublicNotices/Notices/Attachment.aspx?id=125562.

combat some of these impacts, the Russian government committed to a public-private partnership to invest 5.5 trillion rubles (around $82 billion at the time of the agreement) to further regional infrastructure and natural resource development in Siberia and the AZRF.[46] Putting that figure into perspective, this is equal to the Russian national annual budget for health and education. The financial scale of this partnership is likely to be inappropriate for the U.S. response in Alaska, but perhaps this kind of public-private partnership would be one way of building resilience in the U.S. Arctic, especially as there appears to be little appetite from the public sector to fund these kinds of programs. Alyeska Pipeline, the company responsible for the running of TAPS, is modeling some of these initiatives through their philanthropy program;[47] broadening this would be an effective way to commence a public-private partnership.

Shoring up civilian infrastructure in a manner similar to the suggestion for the DoD above would also enable deepening of partnerships with public and private sector actors. The oil and gas industry already holds a significant amount of institutional knowledge to mitigate factors causing instability in infrastructure in the region – leveraging this knowledge could provide more robust infrastructure at less direct cost to the taxpayer.

Bracing for change: meeting community needs

The efforts of the DoD and the energy sector to rebuild or reinforce existing infrastructure have been somewhat successful, but sometimes these options are not feasible. In these instances, entire communities need to relocate. Moving an entire community is a lengthy, expensive process, and is realistically the only alternative for Alaskan communities like Newtok, Shishmaref, and Kivalina.[48] However, the United States is not the only nation facing these kinds of logistical challenges. Much could be learned from the relocation of Kiruna, a northern mining town in Sweden. Here, relocation is a process that has taken decades, and is not due to be completed until the year 2035. The cost is estimated to be in excess of €1.3 billion ($1 billion).[49]

However, the relocation of Kiruna can be distinguished from the relocation of most of the Alaskan communities in question. According to data compiled by the Council on Foreign Relations, many communities in Alaska are failing to meet the thresholds of clean water, sanitation and energy infrastructure set out under the UN Sustainable Development Goals.[50] In some respects, this would make moving communities easier, but in others it causes potential diplomatic embarrassment for the United States, as it demonstrates a failure to meet the basic needs of citizens. These issues are compounded by a lack of representation for Alaskans at the national level; separation from the Lower 48 and a lack of representation in Congress after the death of

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[46] Atle Staalesen, "Russia Presents an Ambitious 5-Year Plan for Arctic Investment," *ArcticToday* (blog), December 14, 2018, https://www.arctictoday.com/russia-presents-ambitious-5-year-plan-arctic-investment/.

[47] "In the Community / Philanthropy," Alyeska Pipeline, accessed June 21, 2022, https://www.alyeska-pipe.com/in-the-community-philanthropy/.

[48] Joint Ocean Commission Initiative, "Arctic Town Votes to Relocate to Avoid Rising Seas," Ocean Action Agenda, March 2017, https://oceanactionagenda.org/story/arctic-town-climate-change/.

[49] David Nikel, "Kiruna: A Mining Town On The Move In Northern Sweden," Forbes, March 23, 2021, https://www.forbes.com/sites/davidnikel/2021/03/23/kiruna-a-mining-town-on-the-move-in-northern-sweden/.

[50] Thad W. Allen, Christine Todd Whitman, and Esther Brimmer, "Arctic Imperatives: Reinforcing U.S. Strategy on America's Fourth Coast," Independent Task Force Report (Council on Foreign Relations, March 2017).

Representative Don Young means that uniquely Alaskan policy issues do not gain the traction or urgency on the Hill that they currently need.[51] The relocation or any other resiliency-building in these communities will require consensus building on the Hill and significant budgetary availability; all of this requires politicians across party lines and from disparate states to work together and raise awareness of these issues.

Collaboration as the antidote for competition

Even amid past tensions between the United States and Russia, the Arctic has typically been an area of cooperation between the two states. With no military-to-military direct lines of communication, the respective Coast Guards have developed a fairly good working relationship for search and rescue and environmental cleanup. This channel of communication was bolstered through the Arctic Coast Guard Forum and the Arctic Council.[52]

However, since the Russian invasion of Ukraine, the Arctic Council has ceased meetings and all related activities due to Russia's chairing of the Council.[53] This position rotates through member states every two years, but at present it seems unlikely that the activities of the Council will reconvene until the chair passes from Russia in 2023. This is a significant issue, as the Council oversees a number of research projects collating data on the environmental changes in the Arctic and consults with indigenous groups to participate in knowledge sharing. Without the structure of the Council, valuable real-time data is not being collected, which will impact the United States' ability to forecast needs in the short to long term.

To overcome some of these challenges, the United States should look to develop greater ties with other Arctic nations and collaborate on similar research without Russian counterparts until a diplomatic way forward can be achieved. This may include building on the U.S. presence in Greenland, such as bolstering the Department of State outreach in Nuuk and focusing on learning opportunities from other nations. Deciphering what lessons are transferable to the U.S. Arctic – either from large-scale initiatives, like Sweden's relocation of Kiruna, or from indigenous groups like the Saami – will potentially avoid a trial-and-error approach, which requires more time than the United States currently has to problem-solve these issues.

Conclusion

Meeting the challenges that climate change is bringing to the Arctic will not be easy for the United States. Too much time has already passed to fully mitigate the impacts of sea ice melt and permafrost melt, but recommendations like those above will assist the United States in deepening resilience for the future. Challenges caused by permafrost slump will continue to

[51] Aaron Navarro, "Special Election Set for June to Fill Seat of Late Congressman Don Young," March 22, 2022, https://www.cbsnews.com/news/special-election-alaska-congress-don-young-death/.
[52] Arctic Council Secretariat, *The Arctic Council: A Quick Guide*, 3rd ed., 2021.
[53] Gloria Dickie and Timothy Gardner, "Arctic Council in Upheaval over Russia as Climate Change Transforms Region," *Reuters*, March 3, 2022, sec. World, https://www.reuters.com/world/arctic-council-countries-halt-meetings-over-russias-invasion-ukraine-2022-03-03/.

degrade existing infrastructure, and the United States must be prepared to create innovative solutions that take into account climate data and modelling. Without implementing significant reviews along the lines above and investing in future-proofing existing assets, there is a very real possibility that Russia will become the strongest actor in the region. Cooperation with allies – both in terms of defense and human security – will be key in positioning the United States to defend its interests into the future.

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