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SATCOM on the Ice: Arctic Circle Operations Put to the Test with Climate Change¹

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and Nivedita Raju

Introduction

Arctic nations worldwide find their economic and military ambitions in the North Pole reshaped by climate change. The significant value of the Arctic's natural gas and oil, estimated at "13% (90 billion barrels) of the world's undiscovered conventional oil resources and 30% of its undiscovered conventional natural gas resources,"⁴ fosters rivalries in and outside of the

¹ **DISCLAIMER:** The views expressed in this article are solely those of the author and may not necessarily represent the views of NATO, Allied Command Operations, or Allied Command Transformation, or of their affiliated organizations, SIPRI or Luxembourg University.

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⁴ US Energy Information Administration, 'Arctic oil and natural gas resources' (*Energy Information Administration - EIA - Official Energy Statistics from the US Government*, 20 January

region between the different stakeholders, especially the Arctic nations: Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States. China has also manifested a strong interest in the Arctic. The North Pole is a crucial component of these countries' national defence and security. Bridging the entire globe from the North Pole, the Arctic region serves as the location of the Northern fleet second-strike capabilities of the Russian Navy, and of submarine fleets of some other superpowers.⁵ As a vector of attack, through the North Pole, for the Arctic nations, it also forms corridors for states' global power projection via the land, the air, and most importantly, the sea.⁶

However, worsening effects of climate change could significantly transform geopolitical and strategic dynamics within the Arctic region. This article considers how the melting of the ice caps could require states to reconsider the nature of legal and strategic limitations on stakeholders and the establishment of Arctic settlements as well as means of transportation and communication. As an initial matter, it will be helpful to set out two questions: "What measures and regulatory requirements are needed to minimise the impact of climate change within the Arctic?", and "How do space-based technologies help contribute to stability in the Arctic region?"

Space-based assets constitute a reliable and accessible tool to develop policies in the Arctic, foster stability between the stakeholders and safeguard the region's environment.

The first part of the article will identify security concerns, and highlight the growing economic and military interests in the Arctic, as impacted by climate change. The second part will discuss how space technologies can be used as a transparency and confidence-building mechanism for Arctic nations by

2012) < <https://www.eia.gov/todayinenergy/detail.php?id=4650> > accessed 1 May 2022; USGS 'Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle' (United States Geological Survey, 2008).

< <https://pubs.usgs.gov/fs/2008/3049/fs2008-3049.pdf> > accessed 1 May 2022.

⁵ Jonas Kjellén, 'The Russian Northern Fleet and the (Re)militarisation of the Arctic' [2022] Arctic Review on Law and Politics vol 13; Matthew P. Funaiole, Joseph S. Bermudez Jr., Colin Wall, 'Russia's Northern Fleet Deploys Long-Range Interceptors to Remote Arctic Base' (Center for Strategic and International Studies, 14 April 2021) < <https://www.csis.org/analysis/russias-northern-fleet-deploys-long-range-interceptors-remote-arctic-base> > accessed 1 May 2022.

⁶ Office of the Under Secretary of Defense for Policy, 'Report to Congress, Department of Defense Arctic Strategy' [June 2019] 3.

strengthening both cooperation and coordination between stakeholders to address the issues arising from climate-change-induced activities.

Security concerns in the region

Global interest in the Arctic has steadily increased over the last two decades. Multiple states, whether they qualify as Arctic Nations or not, publish an Arctic-related 'Strategy' or 'Roadmap' on a regular basis to expose the interests they identified and their subsequent vision and goals in the region. This is evident first from the recent expression of interest by the People's Republic of China in the strategic importance of the region. In a November 2014 speech, Chinese Communist Party General Secretary Xi Jinping declared that albeit not sharing a border with the Arctic, China would become a Polar great power.⁷ In January 2018, China then published a white paper disclosing its national ambitions for the Arctic region, with the establishment of research stations, shipping routes and infrastructure, the laying of submarine cables and pipelines, the development of fishing capabilities and the investment in mining and energy.⁸ Designating itself as a 'near-Arctic state', China has drawn a parallel between its territory and the Arctic's climate, environment and ecology⁹ and also took an active part in the drafting of the International Maritime Organization's (IMO) Code for Ships Operating in Polar Waters (Polar Code) of January 2017¹⁰ and the Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean, signed in Greenland on 3 October 2018.¹¹ China's Arctic Policy demonstrates priorities for developing a "Polar Silk Road" consisting of regular sea passages in the Arctic region.¹² These collectively exhibit China's expanding focus on the region.

⁷ Anne-Marie Brady, *China as a Polar Great Power*, (Cambridge University Press 2017).

⁸ State Council Information Office of the People's Republic of China, *China's Arctic Policy* (White Paper 26 January 2018) http://english.www.gov.cn/archive/white_paper/2018/01/26/content_281476026660336.htm (China's Arctic Policy).

⁹ Harriet Moynihan, 'China Expands Its Global Governance Ambitions in the Arctic' (*Chatham House*, 15 October 2018), < www.chathamhouse.org/2018/10/china-expands-its-global-governance-ambitions-arctic > accessed 1 May 2022.

¹⁰ International Maritime Organization, *International Code for Ships Operating in Polar Waters (Polar Code)* 2014.

¹¹ Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (signed October 3, 2018, entered into force on June 25, 2021).

¹² China's Arctic Policy, *supra* note 8.

The Russian Federation also plays an important role in the Arctic due to its vast territory, which allows for broad exploitation of the area and deployment of military facilities and personnel, as well as the conduct of operations such as the Grom strategic nuclear exercise conducted in 2019.¹³ Russia reaffirmed its vision of the Arctic in an “Energy Strategy of Russia for the period up to 2030”, mentioning its intention to “play the stabilising role in oil and gas production dynamics”¹⁴ and to develop “regulatory requirements [...] pertaining to environment protection.”¹⁵

Climate change and the subsequent shift in dynamics has been noted by NATO as well. NATO’s founding treaty enshrines the principle of collective defence,¹⁶ a notion that aims to bind members together to reaffirm the deterrence and defence posture of the Alliance through joint exercises. Some of these exercises, namely, the Trident Juncture 18 and the Exercise Cold Response 2022,¹⁷ took place in the Arctic, “across Norway on land, in air and at sea.”¹⁸ The growing presence of NATO signals a recognition of the broader strategic concerns associated with the region.

Strengthening governance and cooperation

The first effort to foster cooperation in the region was spurred by the initiative to create an Arctic Council, an intergovernmental forum established by the Ottawa Declaration in 1996, gathering the eight Arctic nations as decision-makers, but also the Inuit Circumpolar Conference, the Saami Council and the Association of Indigenous Minorities of the North, Siberia and the Far East of the Russian Federation as permanent participants, as well as non-governmental organisations (NGOs) and non-Arctic states as observers.¹⁹

¹³ Franz-Stefan Gady, ‘Russia Kicks Off Annual Nuclear Forces Readiness Exercise’, (*The Diplomat*, 15 October 2019) <<https://thediplomat.com/2019/10/russia-kicks-off-annual-nuclear-forces-readiness-exercise/>> accessed 1 May 2022.

¹⁴ Ministry of Energy of the Russian Federation, *Energy Strategy of Russia for the period up to 2030* (approved by decree. N° 1715-r of the Government of the Russian Federation 13 November 2009) 60.

¹⁵ *Ibid* 88.

¹⁶ The North Atlantic Treaty (1949), article 5.

¹⁷ NATO, ‘NATO Exercises’ (*North Atlantic Treaty Organization*, 28 March 2022) <https://www.nato.int/cps/en/natohq/topics_49285.htm> accessed 1 May 2022.

¹⁸ NATO, ‘Trident Juncture 2018’ (*North Atlantic Treaty Organization*, 2018) <<https://www.nato.int/cps/en/natohq/157833.htm>> accessed 1 May 2022.

¹⁹ Declaration on the Establishment of the Arctic Council, (September 19, 1996) (Ottawa Declaration).

Altogether, these stakeholders develop coordination mechanisms and discuss visions on common issues related to the Arctic region's exploitation, scientific research and environmental protection.²⁰ The process forging the Ottawa Declaration roused interest in other questions which forwarded the adoption of key agreements strengthening cooperation in the fields of aeronautical and maritime search and rescue,²¹ marine oil pollution preparedness and response,²² and enhanced scientific cooperation.²³ With the expanding exploitation of natural resources and military presence within the Arctic region, prospects for cooperation began to require deeper insight into these issues. The Ottawa Declaration and the agreements mentioned above purport to preserve the local population of indigenous people, particularly their culture and livelihood. Yet, expanding economic and military interests highlighted the need for continued cooperative efforts, as such expansion carries a corresponding need for more infrastructure, information networks, traffic, facilities, waste and resource management, and delimitations for better region management.

In particular, these shifting dynamics led to the need for cooperation targeted at maritime activities in the region, to maintain the steady reminder that the Arctic region should be "a zone of peace and stability" under the Law of the Sea framework²⁴ and committed to the peaceful resolution of disputes.²⁵ Qualified as a "complicated mosaic,"²⁶ the framework governing maritime activities in the Arctic is composed of the Convention on the Law of the Sea (UNCLOS),²⁷ which regulates shipping within the limits of maritime zones of jurisdiction and other more specific laws, guidelines and standards on

²⁰ Ibid.

²¹ Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic (May 2011) (Maritime Search and Rescue Agreement).

²² Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (May 2013) (Marine Oil Pollution Preparedness and Response Agreement).

²³ Agreement on Enhancing International Arctic Scientific Cooperation (May 2017) (Scientific Cooperation Agreement).

²⁴ Convention on the Law of the Sea (signed December 10, 1982, entered into force on November 1, 1994) 1833 U.N.T.S. 399 (UNCLOS).

²⁵ Arctic Council, Kiruna Declaration (May 2013).

²⁶ Arctic Council, *Arctic Marine Shipping Assessment 2009 Report* (April 2009) 50 (Arctic Marine Shipping Assessment).

²⁷ UNCLOS, *supra* note 24.

international shipping, of which implementation is facilitated by the IMO, a specialised agency in the United Nations system.²⁸

However, despite the efforts of these legal instruments, the melting ice creates notable changes in the region by facilitating navigation through formally ice-covered waters.²⁹ Climate change in the Arctic therefore has the potential to initiate further changes in the dynamics, first by enhanced participation of industry lured by the profits of natural resources and maritime transportation, and second, by the increasing deployment of military troops and equipment. These changes may result in weakening the settlement of facilities on the ground and decreasing stability in the region for both civilians and military forces. This new development will require broad and enhanced monitoring capabilities over the region for the main Arctic players to get an accurate situational awareness of the Arctic Circle.

Growing economic and military interests in the Arctic: treading on thin ice

Economic Interests

The melting of ice in the Arctic can trigger a high activity increase. First, there is potential access to two shipping routes, namely the Northern Sea Route (located closer to Russia) and the Northwest Passage (located closer to Alaska).³⁰ Diminishing ice indicates that these passages may be accessible for longer periods of the year while also presenting opportunities for shorter transit time.³¹ In particular, costs for fuel and transit time would reduce by travelling through the Arctic and avoiding the Suez or Panama Canals.³² These Arctic shipping routes would also allow ships to circumvent the risk of piracy on other more frequently traversed routes. While these routes are presently only accessible for a few months of the year, the impact of climate change coupled

²⁸ Arctic Marine Shipping Assessment, *supra* note 26 at 50.

²⁹ NATO, 'Opening remarks by NATO Secretary General Jens Stoltenberg at the NATO Youth Summit 2022 followed by Q&A' (North Atlantic Treaty Organization, 28 April 2022) <https://www.nato.int/cps/en/natohq/opinions_194916.htm?selectedLocale=en> accessed 1 May 2022.

³⁰ Brandon M. Boylan, Dustin Elsberry, 'Climate Change and Maritime Traffic in the Arctic' (Center For Arctic Policy Studies, Policy Brief 4, September 2019) <<https://uaf.edu/caps/our-work/policy-perspectives-files/climate-change-and-maritime-traffic-in-the-arctic-pb4-final-12dec2019.pdf>> accessed 25 June 2022.

³¹ Lindsey Jacobson, 'The Arctic could see ice-free summers by 2035, reshaping global shipping routes' (CNBC, 16 February 2022) <<https://www.cnbc.com/2022/02/16/arctic-summers-could-be-ice-free-by-2035-enabling-faster-shipping.html>> accessed 1 May 2022.

³² *Ibid.*

with necessary infrastructure could result in accessible routes throughout the year within the next decade. However, the status of these routes is unresolved, and various states have expressed interest in these routes, with some conflicting territorial claims. Russia laid territorial claims over the entire Northern Sea Route, which is unrecognised by other states since only portions of the route fall within Russian internal waters.³³ Canada claims a portion of the Northwest Passage, which the United States also does not recognise.³⁴ Given the mass interest in shipping across the Arctic region, these disputed claims require resolution. As mentioned above, other states have also expressed interest in activities in the Arctic region. This interest evidences an increase in stakeholders invested in the region, with a need for technologies and procedures that facilitate coordination, communication, articulation of objectives and information on activities.

Economic activities are not only restricted to the maritime sector. Aviation in the Arctic has similarly transformed over the last few decades.³⁵ Typically, hundreds of commercial flights are conducted between Asia and over Russian airspace.³⁶ Air traffic over the North Pole has grown further recently, due to the ongoing Ukraine crisis and the need for some to reroute flights that previously passed over Russian airspace.³⁷ Both the maritime and aviation industries indicate a need for enhanced coordination and communication to address multi-stakeholder interest in transporting goods and passengers in the region.

Diminishing ice also points to greater accessibility, and increased pursuit of resources in the Arctic. The term “resources” can be used broadly to refer to the deposits of oil and natural gas reserves, the range of available minerals and metals, and even fisheries stocks available in the region.³⁸ The potential for

³³ Gabriella Gricius, 'Geopolitical Implications of New Arctic Shipping Lanes' (*The Arctic Institute*, 18 March 2021) < <https://www.thearcticinstitute.org/geopolitical-implications-arctic-shipping-lanes/> > accessed 1 May 2022.

³⁴ Ibid.

³⁵ Dermot Cole, 'When Boeing proposed the world's largest plane for Arctic shipping' (*Arctic Today*, 11 November 2019), < <https://www.arctictoday.com/when-boeing-proposed-the-worlds-largest-plane-for-arctic-shipping/> > accessed 1 May 2022.

³⁶ Jacopo Prisco, 'Polar express: How airlines are plotting a new route to Asia' (*CNN*, 20 March 2022) < <https://edition.cnn.com/travel/article/north-pole-air-route/index.html> > accessed 1 May 2022.

³⁷ Ibid.

³⁸ Lars Lindholt, 'Arctic natural resources in a global perspective' (*Arctic natural resources in a global perspective, The Economy of the North*, 2006) accessed 25 June 2022.

alternate sources of oil makes the Arctic an attractive region for states, especially those seeking to reduce dependence on imports. Natural gas has already been identified as a key resource by states such as Russia and China, which have initiated a partnership to construct a natural gas pipeline in the region.³⁹ Arctic fish stocks are additionally viewed as a valuable asset, particularly at a time when population growth is at an all-time high in many states.⁴⁰ There are further questions for coordination in this context as well, as climate change could result in species migrating to other regions as Arctic waters grow warm.⁴¹

Military Interests

As economic interests grow, military activities have similarly risen. Over the last decade, Canada, Denmark, Norway, Russia and the US have prominently expanded military capabilities in the region.⁴² Military exercises continue to be conducted in these harsh conditions on a large-scale and more frequent basis, noting the Trident Juncture 2018, Cold Response 2022,⁴³ and Grom 2019⁴⁴ exercises mentioned above. The development of capabilities, coupled with increasing weapons tests and conduct of military exercises, indicate growing scope for the risk of escalation or outright conflict. NATO's approach concerning the region is not enshrined in a clear Arctic strategy yet, and the new Strategic Concept focusing on defence and deterrence, disclosed in June 2022 at the NATO Summit in Madrid refers to potential disruptions in the High North, of "the Allied reinforcements and freedom of navigation across the North Atlantic".⁴⁵

³⁹ Vita Spivak and Alexander Gabuev, 'The Ice Age: Russia and China's Energy Cooperation in the Arctic' (*Carnegie Endowment for International Peace*, 31 December 2021) <<https://carnegiemoscov.org/commentary/86100>> accessed 1 May 2022.

⁴⁰ Amber Himes-Cornell and Stephen Kasperski, 'Assessing climate change vulnerability in Alaska's fishing communities' (*Fisheries Research*, Volume 162, February 2015).

⁴¹ Ibid.

⁴² Siemon Wezeman, 'Military Capabilities in the Arctic: A New Cold War in the High North?' (*SIPRI*, October 2016) <<https://sipri.org/sites/default/files/Military-capabilities-in-the-Arctic.pdf>> accessed 1 May 2022.

⁴³ *Supra* notes 17 and 18.

⁴⁴ Matthew Melino and Heather A. Conley, 'The Ice Curtain: Russia's Arctic Military Presence' (*Center for Strategic and International Studies*, 26 March 2020) <<https://www.csis.org/features/ice-curtain-russias-arctic-military-presence>> accessed 1 May 2022.

⁴⁵ NATO, 'NATO 2022 - Strategic concept' (*North Atlantic Treaty Organization*, June 2022) <https://www.nato.int/nato_static_f2014/assets/pdf/2022/6/pdf/290622-strategic-

A key concern of some states is that growing economic interests, which are outwardly civilian in nature, may serve as support for states to enhance military presence in the Arctic.⁴⁶ In advancing initiatives for infrastructure and access, states are concerned that such activities may be advancing dual interests, wherein the publicly shared objective is presented as benign under the guise of “scientific research” or commercial interest. US annual reports to Congress on the Military and Security Developments Involving the People's Republic of China have raised these concerns, stating that “civilian research could support a strengthened Chinese military presence in the Arctic ocean, which could include deploying submarines to the region as a deterrent against nuclear attacks.”⁴⁷ The recent 2021 US report notes the growing success of Chinese icebreaking technologies such as the Xue Long 2 (the first such vessel to break the ice while moving both forward and backwards) and observes that Chinese interests in the Arctic have presented possible bilateral friction with Russia overuse of the Northern Sea Route, but also opportunities for further cooperation.⁴⁸ Experts have observed the complexities of this relationship with respect to the Arctic, noting Russia's previous position regarding the limited role of non-Arctic states in the region, which has undergone some changes with the evolution of geopolitical dynamics.⁴⁹ However, experts noted that there is slow progress on Russian cooperation with China in the Arctic (demonstrated by a reluctance to allow Chinese investment in upstream projects), which may change with China's growing participation in the region.⁵⁰

Russian capabilities are notable among the five littoral Arctic states, especially the second-strike capability of its ballistic missile submarine force (SSBN).⁵¹ Russia houses more than 80% of its sea-based nuclear deterrent,

[concept.pdf](#) > accessed 30 June 2022.

⁴⁶ Reuters, ‘China mixing military and science in Arctic push: Denmark’ (Reuters, 19 November 2019) < <https://www.reuters.com/article/us-usa-arctic/china-mixing-military-and-science-in-arctic-push-denmark-idUSKBN1Y3116> > accessed 1 May 2022.

⁴⁷ Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China* (Office of the Secretary of Defense, 2019) 114 < https://media.defense.gov/2019/May/02/2002127082/-1/-1/1/2019_CHINA_MILITARY_POWER_REPORT.pdf > accessed 1 May 2022.

⁴⁸ Ibid 136.

⁴⁹ Ekaterina Klimenko, ‘Patterns of and Incentives for Entry into the Arctic and South East Asia’ in Lora Saalman (ed), *China-Russia Relations and Regional Dynamics: From Pivots to Peripheral Diplomacy*, (SIPRI, March 2017) 43 < <https://www.sipri.org/sites/default/files/China-Russia-relations-regional-dynamics.pdf> > accessed 1 May 2022.

⁵⁰ Ibid.

⁵¹ Eric Brewer, Rebecca Hersman and Maxwell Simon, ‘Strategic Stability and Competition in

including at least 7 of its SSBNs, along the Kola Peninsula.⁵² These capabilities are valuable to Russian forces, especially in the context of rising tensions in Europe between nations. For the same reason, access to Arctic sea routes by the Russian Northern Fleet ensure Russia's ability to continue operating in the North Atlantic and are of significant strategic value. US capabilities in the region are similarly essential to US defence. US bases in Greenland and Alaska house sensors and radars for missile warning and facilitate space surveillance by the US Space Command.⁵³ The Arctic region therefore forms an integral element of both US missile defence and its space situational awareness (SSA) capabilities. This overall trend towards modernization and military build-up in the Arctic has led to experts questioning the potential for escalation and the need for tailored risk reduction measures that address these scenarios.⁵⁴

Potential Impact on Arctic communities and environment

Arctic peoples' dependence on fish stocks points to a need for intervention to equitably and sustainably manage natural resources in the region. Melting ice in the Arctic is closely linked with the potential for food insecurity, especially for indigenous communities, if improperly managed.⁵⁵ Notably, increased activity may impact the environmentally-sensitive region and its resident communities in other ways. The "human-induced impacts" associated with increasing activities persistently generate organic contaminants, greenhouse gas pollution, oil pollution, black carbon, heavy metals, noise, radioactivity and acidification.⁵⁶ Such impacts will not be

the Arctic' (CSIS, 6 January 2021) 3 < www.csis.org/analysis/deep-dive-debrief-strategic-stability-and-competition-arctic > accessed 1 May 2022.

⁵² Ibid.

⁵³ Air Force Master Sgt. Tsuyoshi Shinzato, 'USSPACECOM command team visits Thule Air Base, site of North American Air Defense, space tracking' (Space Operations Command, 22 November 2021)

<<https://www.spoc.spaceforce.mil/DesktopModules/ArticleCS/Print.aspx?PortalId=4&ModuleId=703&Article=2855313>> accessed on 25 June 2022.

⁵⁴ Wilfred Wan, *Nuclear Escalation Strategies and Perceptions: The United States, the Russian Federation, and China* (United Nations Institute for Disarmament Research 22 June 2021) 18-19 < <https://undir.org/escalation> > accessed 1 May 2022.

⁵⁵ Inuit Circumpolar Council, 'Food Security across the Arctic' (Background paper of the Steering Committee of the Circumpolar Inuit Health Strategy, May 2012) <https://www.inuitcircumpolar.com/wp-content/uploads/2019/01/icc_food_security_across_the_arctic_may_2012.pdf> accessed 25 June 2022.

⁵⁶ Frank Sejersen, *Rethinking Greenland and the Arctic in the Era of Climate Change*, (Routledge Publishing 2016) 33.

“contained” or restricted to a particular region but are “locally and regionally non-containable due to the wind, the sea currents and the movement of ice”.⁵⁷ This indicates that increasing activities, including potential pollution, in the Arctic will have substantial effects on other geographical locations as well. These impacts are not easily undone. For example, an accidental oil spill in these waters would irreversibly alter the Arctic ecosystem and is far more challenging to address, given that there is no existing technology to clean oil spills in such harsh conditions.⁵⁸ Similarly, the impact of drilling for oil in the region may threaten species in the area and upend the entire ecosystem to the detriment of all stakeholders. For these reasons, due caution must be exercised in undertaking these activities, which has been acknowledged by some states’ recent efforts.⁵⁹

Indigenous communities residing in the Arctic have also articulated their concerns about increasing activity as a result of climate change.⁶⁰ Studies exhibit the rising safety and security threats associated with national and international marine traffic. These concerns range from pollution and potential accidents that affect the Arctic environment and food sources for the communities, to the lack of notifications regarding the identity of foreign vessels and unclear objectives behind activities.⁶¹ The needs of these communities must be safeguarded in the face of growing activities. Therefore, implementing a precautionary approach through coordination between interest groups in an inclusive manner will be essential.

Mitigating the impact of climate change in the Arctic: a solution from outer space

⁵⁷ Ibid.

⁵⁸ Stephanie E. Chang, Jeremy Stone, Kyle Demes and Marina Piscitelli, ‘Consequences of oil spills: a review and framework for informing planning’ (*Ecology and Society*, Vol. 19, No. 2, June 2014).

⁵⁹ Rachel Frazin, ‘Biden administration shrinks area eligible for drilling at Arctic reserve’ (*The Hill*, 25 April 2022) < <https://thehill.com/policy/energy-environment/3463023-biden-administration-shrinks-area-eligible-for-drilling-at-arctic-reserve/> > accessed 1 May 2022.

⁶⁰ Duane Smith, ‘Climate Change In The Arctic: An Inuit Reality’ (*UN Chronicle*, 24 May 2007) < <https://www.un.org/en/chronicle/article/climate-change-arctic-inuit-reality> > accessed 25 June 2022.

⁶¹ Nicolien van Luijk, Jackie Dawson, Natalie Carter, Gloria Song, Colleen Parker, Kayla Grey and Jennifer Provencher, ‘At the Front Lines of Increased Shipping and Climate Change: Inuit Perspectives on Canadian Arctic Sovereignty and Security’ in Lassi Heininen, Heather Exner-Pirot and Justin Barnes (eds), *Arctic Yearbook* (2021).

The recent rise of tensions between Arctic nations outside of the region could trigger an escalation and jar the semblance of cooperation between the different stakeholders. In the Arctic, stakeholders are faced with multiple challenges that require predictability of ice movements, and detailed mapping and understanding of the area. For this reason, managing ships requires constant monitoring to ensure quick search and rescue missions if a ship is grounded in water that turned to ice, or in case of a collision with a glacier. Furthermore, with regard to the protection of the Arctic environment, authorities have to be able to mitigate risks (i.e. oil spills) after safety hazards or accidents.⁶² In this context, space-based technologies play a significant role in the observation of the sea ice extent,⁶³ the detection of zones of military and economic interest, the verification of states' compliance with their international obligations, the localisation and tracking of boats, vessels, aircraft and land vehicles, the broad coverage of the region to communicate and more specifically convey distress signals.⁶⁴ In addition, space technologies can also be used to monitor negative impacts of safety hazards or accidents, prevent illegal activities and protect the ecosystem, or gather intelligence on a strategic situation for military or security purposes.⁶⁵

Pursuant to Article 57 UNCLOS, a country's exclusive economic zone (EEZ), which extends 200 nautical miles off their shores, within which states have exclusive sovereign rights and jurisdiction over resources and trade.⁶⁶ Beyond this area, the high seas are free, under conditions, and reserved for peaceful purposes.⁶⁷ Following this line, the North Pole of the Arctic Region is not under

⁶² Arctic Marine Shipping Assessment, *supra* note 26 at 10.

⁶³ *Ibid* 25.

⁶⁴ US Department of Commerce, National Oceanic and Atmospheric Administration, Search and Rescue Satellite Aided Tracking, Cospas-Sarsat System Overview <<https://www.sarsat.noaa.gov/cospas-sarsat-system-overview/>> accessed 25 June 2022; European Space Agency, Applications, 406 Day: how Galileo helps save lives <https://www.esa.int/Applications/Navigation/406_Day_how_Galileo_helps_save_lives> accessed 25 June 2022.

⁶⁵ European Space Agency, Enabling & Support, The Contribution of Space Technologies to Arctic Policy Priorities <https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/The_Contribution_of_Space_Technologies_to_Arctic_Policy_Priorities> accessed 25 June 2022; Alla Pozdnakova, 'Space Infrastructure for a Sustainable Arctic: Opportunities and Challenges of Spaceport Development in the High North' (*The Arctic Institute*, 31 May 2022), <<https://www.thearcticinstitute.org/space-infrastructure-sustainable-arctic-opportunities-and-challenges-spaceport-development-high-north/>> accessed 25 June 2022.

⁶⁶ UNCLOS, *supra* note 24, article 57.

⁶⁷ *Ibid*, article 88.

the sovereignty or jurisdiction of any nation. However, some powers consider parts of the Arctic seas as national waters, on which they can impose rights to passage.⁶⁸

Notably, the delimitation of what constitutes the Arctic region provides an illuminating window into the strategic importance of the zone, often considered as one region, defined as the North of the Polar circle or the zone around the North Pole.⁶⁹

Because of scientific, military and economic projections stemming from human activities in the Arctic region, the demarcation of the zone is subject to political considerations based on the balance of power between the Arctic nations and investments from commercial and financial entities. These activities occur in a very peculiar region that constantly challenges humans to adapt. The melting of the Polar region accelerates the transformation of its environment and tends to reshuffle the cards on the region's exploitation by states and industrial players.⁷⁰ Now, the global rise of temperatures is a factor of mutation of the Arctic environment, causing the reduction of the ice floe, the permafrost, and the glaciers with a transformation of the perennial Arctic sea ice.⁷¹ Together with the potential of the region for natural resources extraction and military competition, human-induced climate change is an aggravating factor affecting the Arctic environment and causing weather anomalies which adds to a situation of tension and potential conflict between states by "causing dangerous and widespread disruption in nature and affecting the lives of billions of people around the world."⁷²

In 2011, the US Department of Defense recorded the effects of thawing permafrost and erosion of shorelines and riverbanks and observed that these changes threaten defence infrastructure.⁷³ Climate change therefore poses

⁶⁸ Ibid, article 234; Stanley P. Fields, "Article 234 of the United Nations Law of the Sea: The Overlooked Linchpin for Achieving Safety and Security in the US Arctic?", (*Harvard National Security Journal*, 2016).

⁶⁹ Sejersen, *supra* note 56, 5.

⁷⁰ Ibid at 7.

⁷¹ NASA, 'The Arctic Perennial Sea Ice Could Be Gone by End of the Century' (NASA, 23 October 2003) < https://www.nasa.gov/vision/earth/environment/Perennial_Sea_Ice.html > accessed 1 May 2022.

⁷² IPCC, 'Climate change: a threat to human wellbeing and health of the planet. Taking action now can secure our future' (*Intergovernmental Panel on Climate Change*, 28 February 2022) < <https://www.ipcc.ch/2022/02/28/pr-wgii-ar6/> > accessed 1 May 2022.

⁷³ US Department of Defense, *Report to Congress on Arctic Operations and the Northwest*

direct threats to these very crucial bases, in particular potentially impacting long-range missile warning radar stations.⁷⁴ The US Department of Defense released a report in April 2022, which investigates climate-based threats to infrastructure in the Arctic and the need for an approach to adapt facilities to build resilience against these threats.⁷⁵ The report observes that climate change has caused heavy flooding, resulting in extensive damage to runway shoulders and aircraft hangars.⁷⁶ Out of 79 US military installations overall, more than two-thirds are now vulnerable to worsening flooding, while more than half are vulnerable to increasing drought and wildfire, respectively.⁷⁷ The report concludes with recommendations for intensive planning, risk assessments and policy changes that account for climate change adaptation and resilience.⁷⁸

As major regional players recently started to re-develop their presence and capabilities within the Arctic, they must keep in mind the impact of ice melting on their military ambitions. Situational awareness of the area is essential to monitor the rapid transformation of the Arctic landscape and subsequent changes in human operations and movements.

With climate change, the Arctic may also become a less harsh environment for the deployment of new technologies and capabilities. Some nations may see it as an opportunity to develop ambitious strategies. As disclosed in the Russian Maritime Doctrine to 2020 published in 2015 by the Ministry of Defence, the Russian Navy is prioritising “Russia's nuclear SSBN fleet, attack submarines, unmanned systems, and the creation of a general purpose marine force able to provide a long- range, high precision strike, non-nuclear deterrent capability.”⁷⁹

Passage (May 2011, 7-12

<https://dod.defense.gov/Portals/1/Documents/pubs/Tab_A_Arctic_Report_Public.pdf > accessed 1 May 2022.

⁷⁴ Ibid, 15.

⁷⁵ Inspector General, *Evaluation of the Department of Defense's Efforts to Address the Climate Resilience of US Military Installations in the Arctic and Sub-Arctic* (US Department of Defense, 13 April 2022) < <https://media.defense.gov/2022/Apr/15/2002977604/-1/-1/1/DODIG-2022-083.PDF> > accessed 1 May 2022.

⁷⁶ Ibid.

⁷⁷ Ibid.

⁷⁸ Ibid.

⁷⁹ Claire Mills, ‘Russia's rearmament programme’ (UK Parliament, Commons Library Briefing, 24 January 2017) 22 < <https://researchbriefings.files.parliament.uk/documents/CBP-7877/CBP-7877.pdf> > accessed 1 May 2022; ‘Maritime Doctrine of the Russian Federation’ (President of the Russian Federation, 2015

In 2021, the commander-in-chief of the Russian fleet declared that three Russian nuclear ballistic missile submarines "have surfaced simultaneously breaking the Arctic ice during drills [...] for the first time in the history of the Russian Navy."⁸⁰ And for a good reason. The ice is becoming so thin that it can now be run through from below, which represents an additional danger for indigenous and non-indigenous people living in the Arctic. Furthermore, the major regional powers regularly fly aircraft over neutral waters in the Arctic region and build military bases. These build-ups can be observed with sensors placed in orbit⁸¹ over the months. For instance, since 2015, the Russian Federation has been upgrading its Arctic-based military facilities.⁸² The same process can be noticed in reopening abandoned military bases built during the Cold War and suspected to host the Kinzhal missile, "an air-launched ballistic missile that can be fitted with nuclear and conventional warheads."⁸³

Climate change is reshaping an unstable landscape where the major stakeholders need to develop mutual trust and cooperation mechanisms. Space-based technologies allow for more transparency and collaboration. Among the available tools used to verify that all the stakeholders are playing by the rules and comply -or do not comply- with their obligations, Earth-observation satellites can assess a situation over time by collecting information on the nature of the facilities and equipment, the conduct of operations, the type of risks that could occur and provide data to analyse the behaviour of a state or a private actor.

<<http://static.kremlin.ru/media/events/files/ru/uAFi5nvux2twaqiftS5yrlZUVTJan77L.pdf>> [in Russian] accessed 1 May 2022.

⁸⁰ Reuters, 'Three Russian submarines surface and break Arctic ice during drills' (*Reuters*, 26 March 2021) <<https://www.reuters.com/article/us-russia-military-arctic-idUSKBN2BI2RZ>> accessed 1 May 2022.

⁸¹ Nick Paton Walsh, 'Satellite images show huge Russian military build-up in the Arctic' (*CNN*, 5 April 2021) <<https://edition.cnn.com/2021/04/05/europe/russia-arctic-nato-military-intl-cmd/index.html>> accessed 1 May 2022; Matthew Holroyd, 'Russian military presence expanding in the Arctic region, satellite images show' (*Euronews*, 7 April 2021) <<https://www.euronews.com/2021/04/07/russian-military-presence-expanding-in-the-arctic-region-satellite-images-show>> accessed 1 May 2022.

⁸² Malte Humpert, 'New satellite images show the speed and extent of Russia's Arctic development' (*High North News*, 10 May 2019) <<https://www.arctictoday.com/new-satellite-images-show-the-speed-and-extent-of-russias-arctic-development/>> accessed 1 May 2022.

⁸³ Jyri Lavikainen, 'Strengthening Russia's Nuclear Forces in the Arctic: The Case of the Kinzhal Missile' (*Center for Strategic & International Studies*, 14 September 2021) <<https://www.csis.org/analysis/strengthening-russias-nuclear-forces-arctic-case-kinzhal-missile>> accessed 1 May 2022.

Diaries and representations of the Polar explorations that took place in the 19th century depict the devastating effects of resource extractions and related activities on the indigenous peoples and cultures, the biodiversity and the environment overall.⁸⁴ With the quantity of evidence from the past regarding the detrimental impact of human-led activities on the polar landscape, states will have to take responsibility and not only focus on the promises of a resource-rich zone but consider the consequences of their activities. The state parties to the Ottawa Declaration committed to creating preventive safeguards to activities, including the conservation and sustainable use of natural resources, the protection of the environment, of biodiversity and the full consultation and involvement of indigenous peoples.⁸⁵

For states to comply with mechanisms ensuring stability in the region and reducing tensions, all players have to balance military and economic strategy on one side with confidence-building measures on the other side. Satellite technologies are efficient tools to monitor growth in maritime and aviation traffic and provide an understanding of a situation. Communications and navigation satellites offer extensive coverage over the region to localise, track and connect the operators conducting scientific, economic and military activities⁸⁶ and to verify whether they act in accordance with the provisions of the Ottawa Declaration, without causing disruption.

State cooperation in aeronautical and maritime search and rescue is an important component of the stability in the Arctic region and is supported by coordination centres in charge of research and rescue operations.⁸⁷ This mutual trust between states is sustained by space-based technologies supporting the exchange of information and the organisation of collaborative response to emergency situations. Among these technologies, state parties to the Maritime Search and Rescue Agreement have to share “real-time meteorological and oceanographic observations, analyses, forecasts, and warnings”⁸⁸ and conduct “regular communications checks and exercises, including the use of alternative means of communications for handling communication overloads

⁸⁴ Sejersen, *supra* note 56, 6.

⁸⁵ Ottawa Declaration, *supra* note 19, preambles.

⁸⁶ Joseph S. Bermudez Jr., 'Ice Curtain: Protecting the Arctic Motherland' (Center for Strategic & International Studies, 25 March 2020) < <https://www.csis.org/analysis/ice-curtain-protecting-arctic-motherland> > accessed 1 May 2022.

⁸⁷ Maritime Search and Rescue Agreement, *supra* note 21, articles 2 and 6.

⁸⁸ *Ibid*, article 9,3(b).

during major search and rescue operations.”⁸⁹ Investment in space-based solutions will therefore facilitate international cooperation through efficient flight management tracking, search and rescue operations, and provide communications for crew and passengers as well as efficient ways to maintain a dialogue between the states.⁹⁰

The Arctic nations recognised the harmful consequences of oil pollution and agreed on preparedness and response operations for the sake of the Arctic residents, people coming to the Arctic and biodiversity in general, above and below the ice layer.⁹¹ With climate change and the quick rise in temperatures, it is more challenging to put in place precautionary measures to avoid oil pollution that could contaminate the marine and coastal environment and its natural resources. Beyond the environment, the effects of pollution can harm military troops, miners, and local communities. Operators can use Earth observation satellites to get complete awareness of the nature, magnitude and seriousness of damage caused by pollution. These technologies can even identify the responsible ship and track its location for the accountability process, and also enable ways of communication in case of life-threatening situations. The exchange of detailed information regarding a situation and its remediation is essential for mutual trust between the states. Indeed, the Scientific Cooperation Agreement also underscores how significant such knowledge is for decision-making, and also highlights the “need for increased actions to mitigate and adapt to climate change.”⁹²

Scientific research, monitoring and assessment is another building block of state cooperation in the Arctic. Carrying out such activities efficiently requires the exchange of technologies and data between the states as well as the conduct of research in a transparent manner beyond the territories delimited by the Arctic nations. Scientific research is boosted by space applications which give the opportunity to connect access and transmit instantaneously and from remote locations, a pool of valuable information. Since communication satellites enhance connectivity, particularly through

⁸⁹ Ibid, article 9,3(j).

⁹⁰ Karen L. Jones, Samira Patel, and Martin N. Ross, 'Closing the Arctic Infrastructure Gap: Existing and Emerging Space-Based Solutions' (*The Aerospace Corporation*, October 2019) <https://csps.aerospace.org/sites/default/files/2021-08/Jones_ClosingArcticGap_10172019.pdf> accessed 1 May 2022 (Closing the Arctic Infrastructure Gap).

⁹¹ Marine Oil Pollution Preparedness and Response Agreement, *supra* note 22, articles 1 and 4.

⁹² Scientific Cooperation Agreement, *supra* note 23, preamble.

broadband data coverage in remote areas, they will be essential for military activities, especially since troops require consistent coverage for operations and for emergency responses. Furthermore, civilians and scientists will need such access to connectivity for their daily activities and scientific research. Instantaneous communication can also prevent misperception of threats and is an incentive for reducing conflict, as it enables stakeholders to share information about their activities. This will in turn help address suspicions or accusations from rivals that could escalate the tensions in the region. In this manner, space technologies can minimise security concerns of states' respective capabilities by providing a means to remotely assess each other's strike force and identify the military exercises conducted for new weapons.

In addition to communication satellites, reconnaissance satellites are an efficient means of verification. They provide valuable information, from awareness of the natural environment to forecasting and observation of human activities.⁹³ Moreover, they allow for mutual understanding as they provide an accurate and reliable mean of verification for states willing to monitor the situation over a specific zone, which could be crucial for the future of peace implementation in the Arctic region. Given that climate change poses threats to all stakeholders, there is a need to adopt new measures for mitigation, of which space-based solutions are critical. Space-based position, navigation and timing technologies, and observation and surveillance sensors have the potential to provide insight into the effects of climate change in the region. This will allow stakeholders to take measures when they see that some operators are acting illegally, particularly those who pollute a specific zone or act in a way that furthers regional instability.

Conclusion

Space technologies can provide a means of predicting the movements above and beyond the ice layer and tracking maritime routes as well as the deployment of assets and facilities. They can also enable states' mutual compliance with their Arctic-related international obligations. Furthermore, remote sensing systems such as synthetic aperture radar data, microwave radiometers, and multispectral optical sensors measure sea ice drifts, track

⁹³ Jana K Hettling, 'The use of remote sensing satellites for verification in international law' [February 2003] Space Policy Volume 19, Issue 1, 33, 39
<<https://www.sciencedirect.com/science/article/abs/pii/S0265964602000632>> accessed 1 May 2022.

icebergs, and help ensure that shipping passages are clear and safe for navigation.⁹⁴ In addition, reconnaissance satellites can verify that public and private entities are acting lawfully and help monitor worrisome situations, especially with regard to environmental protection, illegal activities such as overfishing and military operations that could be wrongly perceived.

Overall, the use of space systems in the Arctic will facilitate discussions across the industry to provide satellite services in available orbits – including collaborating with commercial providers. Increased coverage will improve space domain awareness in polar areas to facilitate greater transparency for state activities, which can be achieved through bilateral and multilateral data-sharing agreements between states. By involving commercial entities in these mechanisms, there can also be multiple sources that contribute to the collection and verification of data, ensuring accurate reports of activities.

Thus, space-based technologies are essential to peace-making processes and stability in the Arctic region. It is imperative to utilize these technologies as a means of furthering cooperative and meaningfully inclusive approaches to mitigate the impact of climate change in the region.

⁹⁴ Closing the Arctic Infrastructure Gap, *supra* note 90.