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Space Science & Technology in the Arctic: Promises of Cooperation and Development amid New Security Challenges

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Abstract:

Space science and technology (S&T) holds great potential for international scientific cooperation in the Arctic, especially concerning climate change. Space-based earth observation, navigation/positioning and communication is of great value to Arctic local and indigenous communities. Space-based S&T is also a prerequisite for development of Arctic shipping and natural resources.

At the same time, space S&T in the Arctic holds dynamics, which may undermine Arctic and international stability and security. The Arctic houses key infrastructure for nuclear strategic stability, weapon systems, early warning, and ballistic missile defense. Arctic high latitudes provide significant advantages to space S&T with the potential for dual use. Space, which now underpins all societies, may become militarized.

Strategic stability safeguards humanity. During the Cold War, there was an effective decision-making process mediated by game theory and modelling. However, new technologies, a far more complex multi-player, multi-nation environment and new space S&T reduce the effectiveness of traditional approaches.

This research proposes to address the current intellectual vacuum by creating a clearer understanding of the parameters, players, technologies, and their interactions and develop a new and robust theoretical basis that will contribute in the longer term towards appropriate and balanced Arctic governance for achieving strategic stability and space security. This research will test the hypothesis that Arctic space S&T destabilizes strategic stability and space security. New theory, empirical overview, and modelling will provide a new intellectual basis for governance of Arctic space S&T for strategic stability and space security in the new era.

Keywords: Arctic, scientific cooperation, sustainable development, space, strategic stability, space security, dual use

1. SPACE SCIENCE & TECHNOLOGY IN THE ARCTIC

Space science and technology (S&T) is key to develop the Arctic as a region of peace, scientific cooperation, and sustainable development for local and indigenous communities.[1]

Space (S&T) plays a key role in science and scientific cooperation in the Arctic, not least for climate change research. There is much international space science and research in the Arctic (and Antarctic) such as by the European Space Agency, EISCAT3D in Northern Scandinavia, etc.

There is also space S&T infrastructure, such as Andøya Space Center in Northern Norway, Esrange in Kiruna in Northern Sweden, the Finnish national space center at Sodankylä in Lapland, Plesetsk Cosmodrome near Arkhangelsk.

High-latitude Arctic locations offer space scientific and technological opportunities. Northern lights research is basic space physics research of applied value concerning space weather and various infrastructure in space and on earth. High latitude locations offer special opportunities concerning ground stations for Polar orbiting satellites and launch locations for small satellites. Svalbard Satellite Station, SVALSAT, near Longyearbyen is a prime illustration.

The Arctic S&T opportunities offer scientific, educational, and economic development opportunities for Arctic communities in high value-added jobs. Examples are Andøya Space Center, Esrange, China-Iceland Arctic Observatory at Kárhóll, Fairbanks, Inuvik, Canada, Plesetsk, etc.

Space-based earth observation, navigation/positioning and communication are also of great value to Arctic local and indigenous communities. Space S&T is foundational to developing Arctic shipping and natural resources. The space

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S&T is, for instance, in generating ice charts or GPS/Galileo/Glonass/Baidou for safer travel in the Arctic.

However, besides Arctic cooperation in science and research and possibilities for sustainable development of transportation and resources for local and indigenous communities, Arctic space S&T may also contribute to destabilize Arctic and international security. Namely, Arctic space S&T relates to the issue of strategic stability between the United States and Russia; space situational awareness and militarization of space; space S&T with dual use potential structurally contributing to distrust and uncertainty; and China as rising space-power seeking Arctic high latitude locations for space S&T. To protect the cooperation and development, it is necessary to understand destabilizing dynamics to mitigate them through governance.

This research program is motivated by the hypothesis that space science and technology (S&T) in the Arctic is an intrinsic part of Arctic security and sustainable development now and in the future. The program will develop new and innovative theory linking space S&T and international security and model the effect of Arctic space S&T on the Arctic security. It will provide an intellectual basis for the advancement of the Arctic governance and cooperation.

2. STATE OF THE ART

Scholarship and strategy have gaps of knowledge on space S&T and its effects on international security. This research responds to this serious gap in modern International Relations (IR) theory. Neither Western, Russian-language nor Chinese-language IR has managed to theorize the interaction between the international system and S&T developments in general. Specifically, there is no theory of the effect of space S&T on strategic stability and space security. IR theory sees S&T as exogenous to the international system and security developments. IR is unique among the humanities and social sciences in not having a developed theory or a sub-field around S&T, unlike History of Science and Technology, Science and Technology Studies, and like disciplines (Арбатов [Arbatov], Дворкин [Dvorkin], 2011, Arbatov, Dvorkin & Oznobishchev, 2012, Mayer, Carpes & Knoblich, 2014c, XIA, 2015, Fan, 2015, Li, Hu, 2018).

2.1 Cold War Theoretical and Arms Control Advances

The appearance of nuclear weapons in 1945 was the last time that IR seriously examined scientific and technological developments for their effects on the international system and international security. Then theorists and strategists addressed the question of the effects of this “absolute weapon”, which made the purpose of armed forces to keep the peace rather than engage in war (Brodie, 1946). These intellectual efforts in game-theory and strategy laid the foundations for mutual deterrence during the Cold War avoiding the use of nuclear weapons, for which Thomas Schelling received the Nobel Prize in economics in 2005 (Schelling, 1960, Schelling, 2006). The US and the USSR developed an elaborate framework of arms control with the Strategic Arms Limitation Talks from 1969 leading to the 1972 Anti-Ballistic Missile (ABM) Treaty and the 1972 Interim Agreement on Limitation of Strategic Offensive Arms. This arms control cooperation was continued after the Cold War with the 1991 Strategic Arms Reduction Treaty (START I) and the 1993 Strategic Arms Reduction Treaty (START II). Of special interest here, President George W Bush renounced the ABM treaty in 2002 paving the way to destabilizing BMD, but he concluded the 2002 Strategic Offensive Reductions Treaty (SORT). In 2010, President Barack Obama negotiated the third Strategic Arms Reduction Treaty (NEW START) with Russia. However, the intellectual underpinnings of strategic stability and arms control have receded in the background in post-Cold War IR scholarship and teaching.

2.2 Post-Cold War Theoretical Regression

Cold War mutual deterrence kept the world safe from nuclear war under dangerous circumstances. That mutual deterrence was built on an intellectual foundation of game theory and strategy. However, today, we are witnessing significantly increased complexity with more nuclear actors and destabilizing modern high-tech systems. We do not have the necessary intellectual basis to create new strategic stability and space security. The complexity is growing with risks of strategic instability and space insecurity, which pose risks with increased likelihood of low-probability events but with catastrophic consequences for humankind.

Today, IR is starting to explore developments such as ICT (for instance, Huawei and 5G infrastructure) and biotechnology (Mayer, Carpes & Knoblich, 2014a, Mayer, Carpes & Knoblich, 2014b). However, space S&T is missing from an overview of the global politics of S&T, despite the key effects of space S&T development as indicated here. At the same time, space S&T today represent qualitative developments destabilizing international security. Their effects are more complex than the appearance of nuclear weapons in 1945 because of more actors possessing more complex technology. The Cold War space S&T in the Arctic, was primarily connected with mutual deterrence and Distant Early Warning from Alaska via Canada and Greenland to the UK and similar warning system on the Soviet Arctic side. The superpowers also engaged in strategic space science in the Arctic, as is historically well-documented (Doel, Harper & Heymann, 2016, Knudsen, 2019). This Cold War Arctic system of space S&T was relatively simple as it was it a bipolar system with simpler technology.

The academic discourse reflects the are knowledge gaps in IR and public discussions of Arctic space S&T for strategic stability. The 2020 Routledge Handbook of Arctic Security represents the state-of-the-art with 35 chapters by the leading experts around the Arctic and wider (Hoogensen Gjørv, Lanteigne & Sam-Aggrey, 2020). Yet, there is no chapter on S&T in general, nor space S&T in particular. The current knowledge gaps are a disciplinary regression from the Cold War interdisciplinary understanding of the interplay between

geography, bipolarity and nuclear weapons, delivery systems, early warning, and arms control (Lindsey, 1989). Thus, it becomes evident that the traditional theory and academic approach to strategic stability are not able to explain this complexity and provide solid ground for maintaining stability. In this regard, current IR must develop a theory that can underpin future strategic stability and space security, as post-1945 scholarship underpinned stable mutual deterrence.

3. RESEARCH VISION AND CONCEPT

The Arctic was and remains a keystone of global strategic stability because of its geographical location connecting North America and Eurasia. The Arctic requires the better governance of its space S&T, supported by the dialogue and raising transparency between the United States and Russia. Such conditions provide a set of urgent cognitive needs: we need to understand the relevance of existing theory with Cold War origins for strategic stability under new complexity; we need to build a new game theoretical basis for strategic stability and space security; we need to build and test models of strategic stability and space security based on pooling empirical overview, and new games; we need to understand deficiencies of current governance of space S&T in the Arctic for strategic stability and space security.

The main research question here is: What is the effect of Arctic space S/T on Arctic and international security? This main research question tests the hypothesis that Arctic space S&T can destabilize strategic stability and space security and thus threaten Arctic cooperation and sustainable development. The research vision is to address this current intellectual vacuum by creating a clearer understanding of the parameters, players, technologies, and their interactions and develop a new and robust theoretical basis that will contribute in the longer term towards appropriate and balanced Arctic governance for achieving strategic security and space security. This research fills the knowledge gap of lack of theory and technical empirical overview to understand this destabilization and to mitigate against it through governance.

4. METHODOLOGY AND RESEARCH DESIGN

The methodology will theorize, inventory, game, and model with implications for governance across IR and space S&T.

The research team should use data from open-source academic and political texts across English, French, Russian, Chinese, and Scandinavian. We would use automated text analysis for conceptual developments over time. The inventory of Arctic space S&T is based on public budgets, plans, reports, etc., from academia, companies, government, national and international research funding agencies.

The need for improving trust and mutual awareness underscores the need to make the working process and results Open Access and follow FAIR (Findable, Accessible, Interoperable and Re-usable) data management principles.

5. IMPACT AND RESEARCH OUTPUTS

The scholarly impact of this research would be new and needed theory on the complex impact of Arctic space S&T on Arctic and international security. The methodology and Open Data bibliography, theory, inventory, games, and modelling will be valuable for scholarship in IR, Science and Technology Studies, space S&T and International Space Law, strategy, and governance, also in other regions with pressing strategic instability and space insecurity.

This proposed research would plan to achieve the following outputs to address the knowledge gaps identified in 2. STATE OF THE ART:

5.1 Open Data Multilingual Bibliography

Open Data multilingual bibliography of relevant academic and strategic literature in English, French, Russian and Chinese as well as Scandinavian. This bibliography will show interaction between texts with responses between these academic and strategic documents. This research can then produce new and innovative theory on space S&T and strategic stability and space security moving the field forward from Cold War era scholarship.

5.2 Open Data Inventory of Space S&T in the Arctic

Open Data inventory of space S&T in the Arctic. This Open Data will be visualized with charts, maps with layers of information and interlinkages between localities, systems and science, and infographics.

5.3 Game Theoretical Understanding of Arctic Space S&T

New game theoretical understanding of effects of Arctic space S&T for strategic stability and space security updating from the game theory of the simpler Cold War system. To propose and validate models of strategic stability and space security pooling technical inventory, dual use understanding and game theoretical basis. The models would explain strategic stability under conditions of escalation of extra-regional crises and space security under complexity with dual use, multiple actors, and the rise of China.

5.4 Identify Governance Deficiencies

Identify deficiencies in current governance of Arctic space S&T threatening strategic stability and space security.

These research outputs could be the foundation for future contributions to governance of Arctic space S&T through, for instance, a proposed Arctic space S&T subsidiary of the Pugwash Conferences on Science and World Affairs and training the future generations of scholars and strategists in interdisciplinary Arctic space studies PhD programs.

This research aims to boost the open dialogue on Arctic space S&T, thus contributing to the raising of mutual awareness and cooperation for the security of all actors in the region.

6. REFERENCES

Арбатов [Arbatov], A. & Дворкин [Dvorkin], B. (2011) Стратегическая стабильность до и после холодной войны [Strategicheskaya stabil'nost' do i posle kholodnoy voyny. Mirovaya ekonomika i mezhdunarodnyye otnosheniya/Strategic stability before and after the Cold War]. *Мировая экономика и международные отношения [World Economy and International Relations],* no. 3, pp. 3-11.

Arbatov, A.G., Dvorkin, S.K. & Oznobishchev, M. (eds) (2012). *Russia and the Dilemmas of Nuclear Disarmament*, IMEMO RAN, Moscow.

Brodie, B. (1946). The absolute weapon: Atomic power and world order. Harcourt, Brace, New York.

Doel, R.E., Harper, K.C. & Heymann, M. (eds) (2016). Exploring Greenland: Cold War Science and Technology on Ice. Palgrave Macmillan, New York.

Fan, J. (2015) "核安全全球治理：历史、现实与挑战 [He anquan quanqiu zhili: Lishi, xianshi yu tiaozhan/Global Governance of Nuclear Safety: History, Reality and Challenges]", *国际安全研究[Guoji anquan yanjiu/International Security Research],* no. 2, pp. 20-39.

Hoogensen Gjørv, G., Lanteigne, M. & Sam-Aggrey, H. (eds) (2020). Routledge Handbook of Arctic Security. Routledge, Milton.

Knudsen, H. (2019). Rockets over Thule? The Politics of Military Research and Rockets in Cold War Greenland. Conference: *Diplomats in science diplomacy: Promoting scientific and technological collaboration in international relations.* Commission on Science, Technology & Diplomacy: Division of History of Science and Technology, Copenhagen, 2019/07/19-20.

Li, B. & Hu, G. (2018). 美国视阈中的中国核威慑有效性 [Meiguo shi yu zhong de zhongguo he weishe youxiao xing/ Effectiveness of China's nuclear deterrence in the U.S. threshold] ", *外交评论(外交学院学报) [Waijiao pinglun (waijiao xueyuan xuebao/Foreign Affairs Review: Journal of Foreign Affairs College],* no. 5, 21-42.

Lindsey, G. (1989). Strategic Stability in the Arctic, The International Institute for Strategic Studies, London.

Mayer, M., Carpes, M. & Knoblich, R. (eds) (2014a). The Global Politics of Science and Technology. Vol.1. Springer, Wiesbaden.

Mayer, M., Carpes, M. & Knoblich, R. (eds) (2014b). The Global Politics of Science and Technology. Vol. 2. Springer, Wiesbaden.

Mayer, M., Carpes, M. & Knoblich, R. (2014c). The Global Politics of Science and Technology: An Introduction. In Mayer, M., Carpes, M. & Knoblich, R. (ed.) The Global Politics of Science and Technology - Vol. 1, 1-35. Springer, Wiesbaden.

Schelling, T.C. (2006). How do you communicate with the enemy? Belfer Center for Science and International Affairs, Harvard Kennedy School of Government, Cambridge, MA.

Schelling, T.C. (1960). The Strategy of Conflict. Harvard University Press, Cambridge, MA.

XIA, L. (2015). On China's Nuclear Doctrine. *Journal of China and International Relations,* 3(1), 167-196.