The New Frontier of Multilateralism: Canadian Policy for Outer Space Debris Removal

Kaleigh Campbell, Kyle Fritz, Spencer Page

Issue

In response to the dangerous congestion of outer space, Canada will need to leverage multilateral partnerships with like-minded actors to ensure that it is poised to reap the benefits of exploration and development in an ecosystem increasingly polluted with debris.

Background

According to the European Space Agency's (ESA's) statistics, there are more than 120,000,000 debris objects in orbit, resulting in over 550 "estimated…break-ups, explosions, collisions, or anomalous events resulting in fragmentation" as of January, 2021 (ESA 2021). The proliferation of spacefaring states (Aerospace Technology 2015) and private actors (Vernile 2018) competing for the commercial and resource gains beyond Earth's atmosphere has stimulated the congestion of outer space. As space becomes progressively congested, especially in low-Earth orbit (LEO), the likelihood of the Kessler syndrome - in which the probability of collision is magnified as the population of orbiting objects multiplies (Newman and Williamson 2018: 32) - increases. Such collisions could catalyze a domino effect whereby debris continues to multiply until the entirety of low-earth orbit is shrouded, rendering space exploration untenable. Consequently, Canada would lose access to a "strategic national asset which underpins everything from [its] national security to [its] ability to connect Canadians living in rural and remote communities" (Government of Canada 2019: 14).

While grappling with these developments, Canada is faced with a "crisis of international cooperation" (Badré and Tiberghien 2020; Khan and McArthur 2020) that has been further exacerbated by the COVID-19 pandemic. This has prompted unilateral policy-making and the growing prominence of populist governance systems (Roswell 2020). Consequently, democratic middle powers, such as Canada, must find ways to collaborate with like-minded actors to address mutual policy ambitions and strengthen the prospects of multilateral cooperation (Benner 2020) on debris removal. These actors will include partners who share a concern for space pollution and Canada's historical commitment to democracy, human rights, and environmental protection, realized through multilateral and institutional engagement (Lee 2002, Cooper 2015). Canada must also balance its foreign policy with that of its neighbour, and while President Biden has not yet revealed his ambitions for American space policy at the time of writing, his administration has signalled the potential for multilateral diplomacy (Etzioni 2021).

This brief will provide an overview of the technological, economic, legal and security barriers to effective debris removal. It will conclude with policy recommendations that will strengthen Canada's position as a multilateral partner for outer space governance on this issue.

Barriers

Technological advancements prompting further space exploration by private and public actors have increased the amount of debris in orbit; however, investment in debris removal lags behind in both sectors. Corporations (such as SpaceX, Virgin Galactic, Blue Origin) leading the privatization of space must acknowledge that "with the increasing use and commercialisation of space, we boost the risk of catastrophic events associated with orbital debris" (McCoustra 2020). Although private endeavours are not lone contributors, both they and state projects contribute to the congestion of space with objects ranging from rocket booster stages and satellites (functional and non-functional) to unused fuel and paint flakes (West 2019a, Hutaglung et al. 2020). Regrettably, even though active debris removal (ADR) mechanisms have been in development for several years (for example, nanosatellites and nets, electrodynamic tethers, space tugs, laser-based approaches), they "remain largely speculative," (West 2019a: 8). A potential direction for further research is the development of robotic capabilities (Aglietti 2020), which could complement Canada's Lunar Exploration Program investment plan of $1.9 billion "to develop and contribute advanced...AI-enabled deep-space robotic systems" (Government of Canada 2019: 10).

Unfortunately, the expenses of ADR are often understood as "sunk costs" (McCormick 2013: 810). When removing space debris, state and non-state actors face prohibitive financial requirements that do not yield significant returns without some form of government intervention or market stimulation (David 2021). Moreover, much of the current debris in space can be attributed to the primary spacefaring states (United States, Russia, and China) and companies concentrated in those countries (Mosher and Kiersz 2017), raising concerns about the "division of responsibilities and costs" (Rajagopalan 2018: 6) and other unresolved legal questions about ownership and fault-based liability in ADR activities (Wheedon 2011). At the same time, outer space has been constructed in the Outer Space Treaty (OST) as a "global commons to be used by all for peaceful purposes and for the benefit and interest of all" (West 2019b). Most actors, spacefaring or not, rely on outer space for telecommunications, environmental monitoring and security. The Government of Canada itself maintains an interest in outer space infrastructure, especially as it pursues investments in satellite-reliant high-speed internet for all Canadians (Justin Trudeau 2020). Accordingly, "space debris is a problem for all actors who use outer space," thus "there is greater common interest in managing the problem" (Rajagopalan 2018: 6). Yet, the long-term sustainability of space as a global commons is increasingly dependent on the "'sustainability' of [its] legal regime," particularly for space debris (Martinez 2019: 2).

The international legal regime for outer space is underdeveloped on matters of space debris. At the transnational level, the five core space agreements are: the Outer Space Treaty (1967)*, the Rescue Agreement (1969)*, the Liability Convention (1972)*, the Registration Convention (1975)*, and the Moon Treaty (1979).[1] Space debris does not feature prominently in any of these treaties, nor is it defined within them. Instead, it was the Committee on the Peaceful Uses of Outer Space's (COPUOS) Space Debris Mitigation Guidelines (SDMGs) (2007), which Canada was instrumental in forming (Gilbert, n.d.), that brought intergovernmental attention to the issue (United Nations Office for Outer Space Affairs (UNOOSA) 2019). These guidelines form a framework that includes recommendations to "limit debris released during normal operations" (UNOOSA 2010: 2), "avoid intentional destruction and other harmful activities" and "limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission" (ibid.: 3). However, its variable implementation could be attributed to the lack of an "enforcement or inspection mechanism" (McCormick 2013: 808) and the "need for the establishment of a legally binding international mechanism to regulate and possibly adjudicate on space debris issues" (Rajapaksa and Wijerathna 2017: 72).

These mechanisms would complement attempts to deter the testing and potential use of anti-satellite weapons (ASATs) - devices which could multiply orbiting space debris and endanger existing infrastructure. Many spacefaring states have already developed anti-satellite capabilities, including China (Coats 2019) and Russia (Harrison et al. 2020). The creation of the United States Space Force "to accelerate space warfighting capabilities" (Kopeć 2019: 123) and counterbalancing efforts made by Japan (Kallender and Hughes 2019) and India (Hussain and Ahmed 2019) have also contributed to anxieties about the further normalization of outer space as a domain of

1 Those agreements marked with an asterisk are those to which Canada is a signatory.

military conflict. Consequently, "the use of ground-based antisatellite weapons and spacebased kinetic weapons [could] lead to the production of a large number of space debris" (Zhao and Jiang 2019: 56). Such a climate creates a dilemma for Canada who must navigate the tension between realizing its potential as "a leader in pushing to construct a peaceful world space legal regime" (Handberg 2004: 1251) and its strategic partnership with Washington, especially as commitments to the North American Aerospace Defense Command (NORAD) remain a central component of Canadian space policy. Debris mitigation, as a norm, could potentially temper the risks of military activities as the space community increasingly emphasizes reducing "the chance for debris-causing events, including destructive tests of weapons systems, as a clear priority" (West and Doucet 2021: 13). Yet, as long as the need to deorbit existing debris remains, gaps in space situational awareness - the modes of identifying and tracking space debris - will render outer space a site of persistent insecurity not just for spacefaring actors, but for all on Earth who rely on space-based infrastructure.

Technological, economic, legal, and military barriers may also overlap in complex ways that complicate debris removal. For example, even with the technology to remove debris, state permission is still required under international law. Article VII of the OST indicates that signatories "shall retain jurisdiction and control over the space objects carried on their registry" (Popova and Schaus 2018: 9). Consequently, attempts to remove junk could be interpreted as a hostile act (Davey 2017) and exacerbate security tensions. Accordingly, Canada must consider comprehensive approaches to the issue of space debris to ensure that policy gaps do not undercut one another.

Canada's Opportunity

Canada has demonstrated an interest in future space exploration, evidenced by its agreement to the US-led Artemis Accords, and its related participation in the Lunar Gateway project. It also has had historical issues with space debris; in 1978 a "Soviet satellite malfunctioned and fell to Earth," which scattered "radioactive debris over northern Canada" (Hutaglung et al. 2020: 3-4). Additionally, Ottawa was one of the founding contributors to the creation of the SDMGs (Gilbert, n.d.). The future of debris removal offers Canada an opportunity to clench a supportive position in space governance and extend its position as a "world leader in environmental performance" (Fraser Institute 2020) to the orbital plane.

Recommendations

1. **Canada should take a public, pro-ADR stance, with a statement of support and a commitment to engaging in ADR efforts with like-minded allies (such as the United States, Japan, the ESA).** While Canada has advocated for a "sustainable space sector" (Government of Canada 2019), it has not determined a stance on ADR efforts. In contrast, groups like the ESA have identified ADR technologies as a "strategic goal" (ESA, n.d.), and the National Aeronautics and Space Administration (NASA) have been directed to "evaluate and pursue…active debris removal" (Office of Space Commerce 2020: 15). Accordingly, to maintain pace with like-minded allies, Canada must pursue a similar policy approach. Concerningly, this may propel Canada into a complex web of ambiguous jurisprudence on liability and space property ownership (Chatterjee 2015; Popova and Schaus 2018), though creative solutions (such as contracts, memorandums of understanding) have been advanced to respond to such issues (Anzaldua and Hanlon 2018). Additionally, the forthcoming congestion of space will only exacerbate the difficulty of ADR missions, thus straining liability complications further. Consequently, the Canadian Space Agency (CSA) must pursue a supportive policy framework for ADR efforts – noting that Canada will be a facilitator, rather than a leader for such activities – and GAC should expedite the promotion thereof to like-minded partners.

2. **Canada should increase investment in private sector innovation that supports multilateral debris removal efforts.** Globalized public-private networks are driving ADR: both the ESA's and the Japan Aerospace Exploration Agency's (JAXA) pioneering missions are spearheaded by private actors (ESA 2020; Weiner 2021). Canada does not possess the capability to remove debris unilaterally, but the technical competencies being generated in its private sector could advance the knowledge-sharing and interoperability required to sustain current and future multilateral ADR efforts. Improving space situational awareness through debris tracking and identification should be a central feature of Canada's contribution. Innovation, Science and Economic Development Canada (ISED) has already partly funded the Montreal startup NorthStar Earth & Space to

build the first private satellite constellation for tracking space debris (Government of Canada 2018). Canada can increase its investments in such projects, contracting actors like NorthStar to generate reliable debris tracking systems and, through GAC, share relevant data with Canada's like-minded Inter-Agency Space Debris Coordination Committee (IADC) partners undertaking debris removal missions. Doing so would allow Canada to carve out an important technical and economic niche in multilateral ADR efforts (situational awareness), support the deterrence of more nefarious applications of debris removal technologies and promote the interoperability necessary for clean-up on a global scale.

3. **Canada should focus on strengthening the international legal regime on space debris removal.** If launching trends continue, non-binding regulations, such as the SDMGs, will be unable to prevent the Kessler Syndrome (Popova and Schaus 2018). While a convention specific to the issue would be optimal, in the past, COPUOS has dismissed such proposals (National Research Council 1995). Instead, the modification of existing legal instruments has been identified as a potential means of strengthening the international legal regime on space debris mitigation and removal (Vedda 2017). Article IV of the Registration Convention, which permits states to provide additional details on registered objects in orbit, is a provision that can be operationalized to address the issue (Haroun et al. 2020). Haroun et al. (2020) propose that, in alignment with this provision, states could label objects as "available for salvage," which would permit states or agencies with the appropriate technologies to deorbit the object and return it to the launching state (ibid.: 6). It is thus recommended that GAC collaborate with the CSA to leverage Canada's membership in IADC. Through cooperation with the CSA, GAC would be well-positioned for coalition building within the IADC, and to propose the modification of Article IV of the Registration Convention to the Secretariat of the UN.

4. **Canada should develop and contribute to an Economic Fund for Space Debris Removal.** ADR efforts are undercut by their exorbitant "sunk costs" which disincentivize research and investment (McCormick 2013: 810). An economic fund mechanism would reward clean launch capacity and successful removal, while stimulating competition and investment for cost-efficient technological advancement (Pelton 2013). Spacefaring actors could pay 5% of their overall costs into the fund and would be eligible for a partial rebate of the original contribution (~20%) once the project has been "certified as a clean "debris-free" launch," and a second rebate (~20%) once the spacecraft has been effectively de-orbited or moved to an orbital graveyard (ibid: 27). The rest of the original contribution would be used to finance the removal of existing debris by certified actors and could be re-invested in the research and development of additional technology to improve ADR capabilities. The Ministry of Finance and ISED should work collaboratively with GAC to develop a Canadian fund at the national level, or in conjunction with the United States, as it remains a central hub of space activity. These efforts could foreground the development of a fund at a global level, which could be administered through an international bank or insurance company (Pelton 2015).

About the Authors

Kaleigh Campbell is a student in Wilfrid Laurier University's Master of International Public Policy program, based at the Balsillie School of International Affairs.

Kyle Fritz is a student in the University of Waterloo's Master of Arts in Global Governance program, based at the Balsillie School of International Affairs.

Spencer Page is a student in the University of Waterloo's Master of Arts in Global Governance program, based at the Balsillie School of International Affairs.

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