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#### The Committee on the Peaceful use of Outer Space ought to:

* **establish an application system for property rights on celestial bodies. Applications and approval of property rights should be granted upon the condition of**
* **open disclosure of data gathered in the exploration of a celestial body**
* **Applications must be publicly announced**
* **Property Rights will be made tradeable between private entities**
* **Property Rights will be set to expire on the conclusion of a successful extraction mission**
* **Private Entities will only be allowed one property right grant per celestial body and cannot have more than one grant at a time**
* **Ban the militarization of outer space**

#### Space-faring nations including but not limited to the United States, the People’s Republic of China, and the Russian Federation should comply to a Code of Conduct that prohibits harmful interference against human-made space objects and reduces practices that contribute to the weaponization of space.

#### The United States federal government should:

#### - mandate post-mission disposal and hardening for all satellite launches

#### - create a new federal agency with the sole authority to manage on-orbit activities and the space environment, including permitting and incentivizing the private sector to develop ADR technology, and providing funds for research and development of ADR tech.

#### US plank enables quick commercialization of ADR tech

Brian Weeden 17. Director of Program Planning for the Secure World Foundation. "US Space Policy, Organizational Incentives, And Orbital Debris Removal". The Space Review. 10-30-2017. http://www.thespacereview.com/article/3361/1

Over the course of the last thirty years, successive US presidential administrations have increased the focus on space debris in national policy decisions. There is a clear movement over time from implementation of national mitigation guidelines to international mitigation guidelines, broader discussion on space sustainability, and improving SSA and collision warning measures. And over the same time, practical steps have been taken towards implementing these policy directives. However, while national policy has recognized the importance of developing remediation capabilities such as ADR, there has not been significant progress towards implementation. To date, U.S. efforts on space debris remediation have been limited to studies by both NASA and the DOD, and relatively small research and development contracts from NASA. The lack of progress is likely due to organizational and political factors, including the lack of clearly defined responsibilities, budget constraints, and a political predilection for national security. Broader theories of how public policy change occurs, and how bureaucracies function, can provide insights into changes that could result in improved progress on dealing with space debris. Among the changes that should be considered is giving an existing, or new, federal agency explicit authority over on-orbit activities and management of the space environment. At a minimum, this authority should be focused on clearly permitting and incentivizing the private sector to develop ADR technologies and capabilities, and possibly even providing government funding for research and development if private sector funding does not materialize. This authority should also be linked with providing of SSA or STM data and services, which would be essential for conducting or providing oversight of ADR. Creating a bureaucratic champion in this manner will help better align bureaucratic incentives with the stated policy goals, and help create the change that will improve the space environment for all future users, public and private.

#### Code of conduct plank solves weaponization and space wars – International norms, verification, SSA transparency

Krepon, Hitchens, and Katz-Hyman 11 [February 2011, Michael Krepon is the President of the Henry L. Stimson Center, Theresa Hitchens is Director of the United Nations Institute for Disarmament Research, and Michael Katz-Hyman is a Research Associate at the Henry L. Stimson Center on the Space Security and South Asia Projects “Preserving Freedom of Action in Space: Realizing the Potential and Limits of U.S. Spacepower”, Chapter 20 in “Towards a Theory of Spacepower: Selected Essays”, SM]

We view a code of conduct for responsible spacefaring nations as a necessary complement to a hedging strategy and as an essential element of a space posture that provides for the preservation and growth of U.S. space capabilities. A code of conduct makes sense because, with the increased utilization and importance of space for national and economic security, there is increased need for space operators and spacefaring nations to act responsibly. While some rules and treaty obligations exist, there are many gaps in coverage, including how best to avoid collisions and harmful interference, appropriate uses of lasers, and notifications related to potentially dangerous maneuvers. Because the increased utilization of space for security and economic purposes could lead to friction and diminished space assurance, it serves the interests of all responsible spacefaring nations to establish rules of the road to help prevent misunderstandings, catastrophic actions in space, and grievances. Another reason for pursuing rules of the road is that interactive hedging strategies could generate actions in space that diminish space security by nations concerned about the import of technology demonstrations and flight tests. We have therefore argued that hedging strategies are best accompanied by diplomatic initiatives to set norms that increase the safety and security of satellites vital to U.S. national and economic security. A code of conduct would serve these purposes. No codes of conduct or rules of the road are self-enforcing. Despite traffic laws, some drivers still speed. But having rules of the road reduces the incidence of misbehavior and facilitates action against reckless drivers. We acknowledge that there are no traffic courts for misbehavior in space, but we nonetheless argue that having agreed rules of the road in this domain will also reduce the incidence of misbehavior, while facilitating the isolation of the miscreant as well as the application of necessary remedies. Without rules, there are no rule breakers. Traditional arms control was devised to prevent arms racing between the superpowers. With the demise of the Soviet Union, concerns over arms racing have been replaced by concerns over proliferation and nuclear terrorism. Cooperative threat reduction initiatives have been designed to deal with contemporary threats. These arrangements have taken myriad forms, including rules of the road to prevent proliferation. Since the flight-testing, deployment, and use of weapons in space would increase security concerns, and since security concerns are drivers for proliferation, agreed rules of the road for space could supplement other codes of conduct that seek to prevent proliferation. Codes of conduct supplement, but differ from, traditional arms control remedies. Skeptics of new arms control treaties to prevent ASAT tests and space-based weapons argue that it would be difficult to arrive at an agreed definition of space weapons, and that even if this were possible, it would be hard to monitor compliance with treaty obligations. A code of conduct would focus on responsible and irresponsible activities in space that, in turn, would obviate the need for an agreed definition of space weapons. For example, a code of conduct might seek to prohibit the deliberate creation of persistent space debris. Again, our focus is on behavior, not an agreed definition of space weapons. Moreover, the deliberate creation of persistent space debris is very hard to hide and can be monitored by existing technical means. The United States has championed codes of conduct governing militaries operating in close proximity at sea in the 1972 Incidents at Sea Agreement, as well as in the air and on the ground, in the 1989 Dangerous Military Practices Agreement. More recently, the United States has championed codes of conduct to reduce proliferation threats, including The Hague Code of Conduct (2002) and the Proliferation Security Initiative (2003). The 2001 Space Commission Report chaired by Donald Rumsfeld also endorsed rules of the road for space. 8 Codes of conduct typically take the form of executive agreements in the United States. They can begin as bilateral or multilateral compacts and they can expand with subsequent membership. Codes of conduct are either an alternative to, or a way station toward, more formal treaty-based constraints that often take extended effort. 9 Some rules of the road, formal agreements, and elements of a code of conduct already exist for space. The foundation document that defines the responsibilities of spacefaring nations is the Outer Space Treaty (1967). Other key international agreements and institutions include the Liability Convention and the International Telecommunications Union. There is growing sentiment among space operators to develop and implement several key elements of a code of conduct, including improved data sharing on space situational awareness; debris mitigation measures; and improved space traffic management to avoid unintentional interference or collisions in increasingly crowded orbits. A more comprehensive code of conduct might include elements such as notification and consultation measures; provisions for special caution areas; constraints against the harmful use of lasers; and measures that increase the safety, and reduce the likelihood, of damaging actions against manmade space objects, such as harmful interference against satellites that create persistent space debris. Key elements of a code of conduct are useful individually, but they are even more useful when drawn together as a coherent regime. Situational Awareness Space situational awareness (SSA)—the ability to monitor and understand the constantly changing environment in space—is one of the most important factors in ensuring the safety and security of all operational satellites and spacecraft. SSA provides individual actors with the ability to monitor the health of their own assets, as well as an awareness of the actions of others in space. Transparency measures can be particularly helpful in providing early warning of troubling developments and in dampening threat perceptions. One measure of U.S. spacepower and space prowess is America's unparalleled space situational awareness capabilities. Thus, the United States is in a position to become a leader in building space transparency, which is the foundation stone of norm setting and rules of the road in space.

#### First counterplan plank establishes international norms for safe extraction of resources on celestial bodies while increasing R&D in outer space.

**Steffen 21** [Olaf Steffen, Olaf is a scientist at the Institute of Composite Structures and Adaptive Sytems at the German Aerospace Center. 12-2-2021, "Explore to Exploit: A Data-Centred Approach to Space Mining Regulation," Institute of Composite Structures and Adaptive Systems, German Aerospace Center, [https://www.sciencedirect.com/science/article/pii/S0265964621000515 accessed 12/12/21](https://www.sciencedirect.com/science/article/pii/S0265964621000515%20accessed%2012/12/21)] Adam

4. The data-centred approach to space mining regulation

4.1. Core description of the regulatory regime and mining rights acquisition process

The data gathered in the exploration of a [celestial body](https://www.sciencedirect.com/topics/social-sciences/astronomical-systems) is not only of value for space mining companies for informing them whether, where and how to exploit resources from the body in question, but also for science. The irretrievability of information relating to the solar system contained in the body that will be lost during resource exploitation carries a value for humanity and future generations and can thus be assigned the characteristic of a common heritage for all mankind as invoked in the Moon Agreement. This characteristic makes exploration data an exceptional and unique candidate for use in a mechanism for acquiring mining rights because its preservation is of public interest and its disclosure in exchange for exclusive mining rights does not place any additional burden on the mining company. The following principles would form the cornerstones of the proposed regulatory regime and rights acquisition mechanism based on exploration data:

Without preconditions, no entity has a right to mine the resources of a celestial body.

An international regulatory body administers the existing rights of companies for mining a specific celestial body.

Mining rights to such bodies can be applied for from this international regulatory body, with applications made public. The application expires after a pre-set period.

Mining rights are granted on the provision and disclosure of exploration data on the celestial body within the pre-set period, proposedly gathered in situ, characterising this body and its resources in a pre-defined manner.

The explorer's mining right to the resources of the celestial body is published by the regulatory body in a mining rights grant.

The data concerning the celestial body are made public as part of the rights grant within the domain of all participating members of the regulatory regime.

The exclusive mining rights to any specific body are tradeable.

The scope of the regulatory body with respect to the granting of mining rights is not revenue-oriented.

The international regulatory body would thus act as a curator of a rights register and an attached database of exploration data. The concept is superficially comparable to patent law, where exclusive rights are granted following the disclosure of an invention to incentivise the efforts made in the development process. In the following section, the characteristics of such a regulatory regime are further discussed with respect to the formation of [monopolies](https://www.sciencedirect.com/topics/social-sciences/monopolies), market dynamics, conflict avoidance, inclusivity towards less developed countries and the viability of implementation.

4.2. Discussion and means of implementation

The proposed regulatory mechanism has advantages both from a business/investor and society perspective. First, it prevents already highly capitalised companies from acquiring exploitation rights in bulk to deny competitors those objects that are easiest to exploit or most valuable, which would otherwise be possible in any kind of pay-for-right mechanism and could result in preventing market access to smaller, emerging companies. Thus, early monopoly formation can be avoided.

The use of data disclosure for the granting of mining rights ensures the scientific community has access to this invaluable source of information. In this way, space mining prospecting missions can lead to a boost in research on small celestial bodies at a speed unmatchable by pure government/agency funded science probes. This usefulness to the scientific community could lead to sustained partnerships between prospecting companies and scientific institutions and could even provide a source of funding for the companies through R&D grants and public-private partnerships. The results of the exploration efforts contribute to research on the formation of planets and the history of the solar system and provide valuable insight for space defence against asteroids. The transition of exploration from a tailored mission profile with a purpose-built spacecraft to a standard task in space flight would also lead to a cost reduction of the respective exploration spacecraft through [economies of scale](https://www.sciencedirect.com/topics/social-sciences/economies-of-scale). This describes the very benefits Elvis [[24](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib24)] and Crawford [[25](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib25)] imagined as possible effects of a space economy. Thus, there is an immediate return for society from the exploitation rights grant. It also reconciles the adverse interests of space development and [space science](https://www.sciencedirect.com/topics/social-sciences/space-sciences) as laid out by Schwartz [[26](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib26)]. It ensures that, by exploitation, information contained in celestial bodies is not lost for future generations.The application period should not be set in a manner that creates a situation that can be abused through the potential for stockpiling inventory rights. Rather, it is intended to prevent conflict in the phase before exploration data gathered by a mission, as a prerequisite to the mining rights grant, is available. In other words, only one exploration effort at a time can be permitted for a specific body. The time frame between the application and the granting of mining rights (meaning: availability of the required exploration data set) should be tight and should only consider necessary exploration time on site, transit time and possibly a reasonable launch preparation and data processing markup. These contributors to the application period make it clear that the time frame could be dynamic and individualistic, depending on the exploration target (transit time and duration of exploration) and the technology of the exploration probe (transit time). After the expiration of the application period, applications for the exploration target would again be permissible. To prevent the previously mentioned stockpiling of inventory rights, credible proof of an imminent exploration intention would need to be part of the application process, for example, a fixed launch contract or the advanced build status of the exploration probe. Such a mechanism would not contradict the statement in the OST that outer space shall be free for both exploration and scientific investigation. Applications would not apply to purely scientific exploration. An application would only be necessary as a prerequisite for mining. Even resource prospecting could take place without an application (for whatever reason), with a subsequent application comprising in situ data already gathered. For such cases, the application process would need to provide a short period for objections to enable the secretive explorer to make their efforts public. The publication of the application for the mining rights, which is nothing more than a statement of intention to explore, thus provides a strong measure for avoiding conflict.

The transparency of where exploration spacecraft are located and, at a later stage, where mining activities take place, provides additional benefits for the sustainable use of space, trust building and deterrence against malign misuse of mining technology. Involuntary spacecraft collisions of competitors in deep space are prevented by the reduction of exploration efforts at the same destination through the application for mining rights by one applicant at a time. As pointed out by Newman and Williamson [[20](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib20)], this is relevant because space debris does not de-orbit in deep space as in the case of LEO. Deep space may be vast, but the velocities involved mean that small debris particles are no less dangerous. Considering NEO mining with fleets of small spacecraft, malfunctions and/or destructive events could create debris clouds crossing Earth's orbit around the sun on a regular basis, presenting another danger to satellites in Earth's own orbit. Thus, by effectively preventing the collision of two spacecraft, one source of debris creation can be mitigated through this regulation mechanism. With respect to Deudney's [[11](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib11)] scepticism of asteroid mining and the dual-use character of technology to manipulate orbits of celestial bodies, it has to be stated that this potential is truly inherent to asteroid mining. An asteroid redirect mission for scientific purposes was pursued by NASA [[49](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib49)] before reorientation towards a manned lunar mission. In one way or another, each type of asteroid mining will require the delivery of the targeted resource to a destination via a comparable technology as formerly envisioned by NASA, be it as a raw material or a useable resource processed in situ, even if this is not necessarily done through redirecting the whole asteroid and placing it in a lunar orbit. However, to be misused as a weapon, space mined resources would have to surpass a certain mass threshold to survive atmospheric entry at the target. This seems unfeasible for currently discussed mining concepts using small-scale spacecraft as described in this article. Redirecting larger masses or whole asteroids would require far more powerful mining vessels or small amounts of thrust over long periods of time. The continuous, (for a mining activity) untypical change in the orbit of an asteroid would make a redirect attempt with hostile intent easily identifiable, effectively deterring such an activity in the first place by ensuring the identification of the aggressor long before the projectile hits its target. The proposed database would provide a catalogue of asteroids with exploration and mining activities in place that should be tracked more closely because of their interaction with spacecraft. This would, in fact, be necessary per se as a precaution to avoid catastrophic mishaps, such as the accidental change of a NEO's orbit to intercept Earth by changing its mass through mining.

#### Space mining fails now due to profitability and unsafe tech which only the cp solves

**Steffen 21** [Olaf Steffen, Olaf is a scientist at the Institute of Composite Structures and Adaptive Sytems at the German Aerospace Center. 12-2-2021, "Explore to Exploit: A Data-Centred Approach to Space Mining Regulation," Institute of Composite Structures and Adaptive Systems, German Aerospace Center, [https://www.sciencedirect.com/science/article/pii/S0265964621000515 accessed 12/12/21](https://www.sciencedirect.com/science/article/pii/S0265964621000515%20accessed%2012/12/21)] Adam

* answers timeframe deficits
* creates solvency vs inequality/developing nation affs

The data-driven mechanism also addresses another potential risk of an emerging space-based resource economy: the reinforcing of the incontestable market positions of the market leaders based on an advantage in knowledge unattainable by new competitors. Explorations of celestial bodies will have a likelihood of failing from the perspective of the actual value of the explored object vs. the expected value. In this case, the costs of exploration would be a loss for the company, which could be significant and possibly ruinous considering the budgets needed for contemporary space agency-led exploration missions. Sanchez and McInnes [[5](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib5)] explicitly mention the uncertainties in object distribution models used in their asteroid distribution study and for the conclusions drawn concerning reachable object masses with certain delta-v capabilities of spacecraft. With an increasing number of exploration missions led by a company, the data collected may lead to better in-house models and a higher probability of exploring the ‘right’ body for the value/resources aimed at. This may even provide information on the best spacecraft designs for matching the targeted objects’ orbit distribution. This risk is known from the digital platform economy, where the companies that are now leading have an uncatchable advantage in user data compared with market newcomers, translatable to a more refined and comfortable user experience, attracting additional users and thus offering superior services to business customers. This also holds true for space mining companies. Through their lack of legacy mission data, market newcomers would have a higher risk of misallocating exploration missions, making investments in those companies riskier than in established companies. To avoid the preferred investment in a single or a few companies, the risk of the investment in emerging companies is reduced by the proposed mechanism by ensuring the equal access to data for market newcomers and established companies alike. From a prospecting risk perspective, the market entrance of a new company becomes progressively less risky for investors with increasing amounts of publicly available exploration data, promoting progressive and dynamic development.

The long lead times of asteroid mining ventures coincide with a long time frame for an ROI. The exclusive mining rights granted after the exploration phase give investors security half-way into their space mining endeavours. The proposed tradability of the rights offers an early chance of gaining investment proceeds. It also offers the possibility of new business models: the classical asteroid mining system concept, as shown by Andrews et al. [[43](https://www.sciencedirect.com/science/article/pii/S0265964621000515#bib43)], for example, covers exploration, exploitation and resource transfer. This maximises the investment needed to develop the technologies required for the entire process chain. Giving exploration a value could lead to a division of labour. Dedicated prospecting companies could emerge, providing mining companies with the data and mining rights to a body with the specific resource profile they are seeking. In this way, the investment needed for a successful mining endeavour is divided between different specialised companies. This considerably reduces the risk for investors as well as the investment needed for a company to meet their business goals, which are now aimed at just a particular part of the overall space mining endeavour. Third-party applications for mining rights should be possible to allow a mining company to subcontract to exploration companies. Such a regulatory mechanism design would also be more easily inclusive of less developed countries. They could simply contract exploration missions made affordable through economies of scale to become part of the emerging space mining economy as holders of tradeable mining rights. Through a wise selection of such missions’ targets, they could gain powerful positions of influence.

#### Creating clear rules of the road now prevents China and Russia from normalizing space militias

Adam Routh 17, Routh is a research associate with the Defense Strategies and Assessments Program at the Center for a New American Security. Before that, he served with the U.S. Army’s 75th Ranger Regiment, “Op-ed | Is the U.S. ready for China’s ‘space militias’?,” Space News, 11/20/17, https://spacenews.com/is-the-u-s-ready-for-chinas-space-militias/

Economic interests in space continue to rise. In 2016 the global space economy represented $329 billion, and 76 percent of the total was produced through commercial efforts. With some of the most lucrative endeavors like asteroid mining, space tourism, micro satellites, and space colonies still in the early stages of development and application, it’s no wonder economic projections estimate the space sector will grow to $2.7 trillion over the next three decades.

Nations’ militaries will continue to protect vital economic interests, and outer space will be no exception. But how will it happen? Will the United States see peer competitor militaries expand more aggressively into outer space? The answer lies in gray zone tactics and space militias.

The operational complexities of the space environment coupled with poorly defined international norms and laws will likely encourage U.S. adversaries to use gray zone tactics. Chinese maritime militias provide a likely model.

Maritime militias are merchant and commercial vessels that, when called upon, support roles similar to those found in law enforcement, disaster relief, and the military. Maritime militias are rather common around the world and often serve useful missions. There are also maritime militias, however, that do more than serve peacefully.

Aside from Vietnam, China’s maritime militia is the only such organization that routinely harasses law abiding foreign vessels, among other aggressive activities. For example, in 2012 Chinese maritime militias participated in China’s seizure of the Scarborough Shoal from the Philippines. In 2015, when the USS Lassen sailed by Subi Reef, China used maritime militias to communicate Chinese opposition. These militias have become increasingly professionalized while still maintaining an ambiguous civilian affiliation, and herein lies the problem. The civilian nature of these militias provides Beijing the ability to deny involvement while making any sort of response from the United States, or others, very difficult. Even worse still, the use of maritime militias in this way allows China to undermine international law and begin to set legal precedence in their favor. Given the proven success of this tactic, the United States should anticipate similar approaches via space militias.

Space militias could operate much in the same way maritime militias act currently. Space militias will be commercial (or at least appear to be commercial) spacecraft supporting commercial activities but when directed by their government will quickly adjust and adopt a more military or law enforcement like role. The United States should expect these space militias to defend territory, provide situational awareness, and even attack other spacecraft through a variety of anti-satellite systems, but instead of people, these commercial spacecraft will rely on automation and artificial intelligence for basic operations. Without human life at stake risk tolerance will surely increase.

The complex environment of space will make this tactic very appealing. The vast distances between asteroids, planets and orbits means communications, situational awareness, and replacing or reinforcing spacecraft will be time consuming. This environment provides ample reason for states unconcerned with the separation of civilian and military entities to employ commercial platforms to achieve military objectives in a well-integrated and organized way.

To the benefit of those who would employ the gray zone tactics described above, laws and norms about the commercial and military use of space remain unsettled. While the 1967 Outer Space Treaty prohibits claims of sovereignty over celestial bodies, it doesn’t say anything about owning the resources extracted from said bodies. The treaty does require a nation-state to supervise its public or private organizations operating in space, but it doesn’t detail what constitutes adequate oversight. Outside the 1967 Outer Space Treaty, international space law is poorly defined and understood. Making matters worse, there isn’t any international organization designed to address commercial space activities. The lack of rules and regulatory bodies creates an ideal situation for space militias.

While the United States currently has a significant advantage in commercial space ventures, China is catching up quickly. Before China develops and normalizes the use space militias, the United States should pursue international agreements with partners nations that create clear laws, regulations, and norms that govern commercial activities in space. These agreements should not replace the 1967 Outer Space Treaty but, instead, supplement it. They should address commercial rights including definitions for demarcating claims and their operational zones, identification requirements differentiating civilian and military spacecraft and operations, and the creation of earth-bound organizations which serve as regulatory and legal forums for the creation of space customs and handling of space disputes. U.S. adversaries will deploy offensive military capabilities in space to defend their economic interest. The U.S. must proactively establish rules of the road before peer competitors gain the advantage by normalizing space militias.

#### International cooperation over mining prevents weaponization of asteroids

Jakub Drmola and Miroslav Mareš 15, both have a PhD in Political Science from Masaryk University, “Revisiting the deflection dilemma,” Astronomy & Geophysics, Volume 56, Issue 5, October 2015, Pages 5.15–5.18, https://doi.org/10.1093/astrogeo/atv167

The risks of mining asteroids

There are two basic ways to go about moving the resources contained within a given asteroid to the Earth. They can be extracted from the asteroid during its natural orbit and then transported to the Earth, or the entire asteroid might be moved closer to a more convenient location before starting mining. Thus repositioned, it might even be used as a shielded habitat, once hollowed out (Ostro 1999). There are different speculative costs and benefits associated with either option, which would vary with the size, orbit and composition of the asteroid. But, crucially, the second option would entail putting asteroids into orbit around the Earth, the Moon or possibly at one of the Earth's Lagrangian points. Indeed, NASA has already planned a mission to capture a small asteroid and place it in a high cislunar orbit, where it would serve as a destination for future manned missions and experiments. This “Asteroid Redirect Mission” is to take place in the next decade and is being pitched mainly as a stepping stone towards a future mission to Mars (see box “NASA's Asteroid Redirect Mission”; Brophy et al. 2012, Burchell 2014, Gates et al. 2015).

Programmes to redirect asteroids and, especially, plans to mine asteroids on an industrial scale essentially resurrect the deflection dilemma. But it is no longer a matter of superpowers intentionally misusing technology designed to prevent dangerous impacts. It becomes an issue of proliferation among private entities. Once private mining companies acquire the technical ability to redirect suitable NEOs (Baoyin et al. 2011) in order to extract platinum or water from them, perilous inflections become more likely.

The probability of accidents will rise with the number of asteroids whose trajectories we decide to manipulate. Such accidents might be very unlikely, but even a tiny technical or human error in the execution of an inflection meant to place an asteroid into the lunar or geocentric orbit might send it crashing into the Earth with potentially devastating consequences. And while we might find solace in the low probabilities associated with such an accident, even contemporary industries which are considered very safe suffer from unlikely tragedies. Despite being dependable and reliable, airliners do crash; there are a lot of them flying and very improbable accidents do happen if the dice are rolled often enough. Undoubtedly, we will not be steering as many asteroids as we steer planes any time soon, but industries tend to be more accident-prone during their infancy. Furthermore, a single asteroid can do a lot more damage than a single plane. And who is to say how much metal or water we are going to need in space over the course of the 21st century, or the next?

The second source of risk is the intentional misuse, similar to the original deflection dilemma. But the entry barrier for asteroid weaponization gets much lower if mining them and moving them around becomes a common industrial activity. This is in stark contrast to the original scenario which envisioned this technology to be used solely for planetary defence and under control of a very small number of the most powerful countries (Morrison 2010). If such a powerful technology becomes widely and commercially available, even rogue states and well-funded terrorist groups might be tempted to use it for an unexpected and devastating attack. In addition, an active asteroid mining industry would make it more difficult to detect any hostile inflection attempts among the number of legitimate and benign ones.

Policy implications

Considering these possible future dangers, it seems prudent to consider what to do about them sooner rather than later. The most obvious “solution” would be a blanket ban on the development of any technology that might lead to artificially inflected asteroids crashing into the Earth. However, such a ban would be incompatible with the dream of increased presence of humans in the solar system. It would stymie both scientific exploration and economic development here on Earth, which is increasingly dependent on precious metals and space-based technologies. Furthermore, this approach would leave us more vulnerable to natural impacts which, in the long view, seems less than desirable.

Another approach might be similar to the current regime of non-proliferation of nuclear weapons, aiming to support peaceful civilian use of nuclear power while at the same time prohibiting the spread of weapons of mass destruction. The regime mostly works (with caveats, see Wood et al. 2008) because these applications require different infrastructures and fissile materials enriched to different levels of purity. This makes it possible, at least in principle, to tell apart operations meant for the production of electricity and those designed to create weapons. Unfortunately, the difference between legitimate and hostile trajectory modification would lie only in the acceleration imparted on the asteroid and not in the technical means to do it. As the spacecraft launched with the intent to cause impact with the Earth might be identical to those sent off to retrieve resources, telling them apart would be nearly impossible, until it was too late. And this approach makes no difference to the chances of an industrial accident.

If monitoring equipment on Earth is unhelpful, the focus changes to space. In other words, all asteroid movement missions should be constantly monitored. For an attacker, it would make most sense to delay the final course adjustment for as long as possible in order to give the least warning and make the timeframe for reaction as short as possible. So an asteroid might head towards a safe orbit fit for resource extraction for most of its altered flight time, but be further accelerated at the last possible moment onto an impact trajectory, perhaps mere days before it hits a major city.

Our current programmes cataloguing NEOs (such as CSS or Pan-STARRS), which look for new, previously unknown objects, are not ideally suited for the task of constantly tracking a number of different, already known asteroids. New instruments would be needed to track them in order to immediately detect any hazardous inflection, whether intentional or accidental. Once such a detection is made, emergency measures to evacuate the population or, preferably, to “re-deflect” the incoming object can be executed right away, regardless of the cause. Accidents and hostilities could be treated the same way and countered by the same system (initially, at least). Such a system would be more akin to an air traffic control than a non-proliferation regulation, offering security through vigilance, rather than absence. Additionally, development of a system able to deflect incoming objects at relatively short notice would be beneficial in case of an impending natural impact.

### 2

#### Asteroid mining is only possible by private, commercial actors appropriating space – mining asteroids makes space exploration sustainable and solves environmental destruction on Earth

Britt, 2021

Hugo Britt, Ph.D. Doctor of Philosophy in English Literature University of Melbourne, is a freelance content writer who believes that every topic is fascinating if you dig deeply enough. Hugo is the co-founder of content marketing agency Discontent. “Companies Are Preparing for Space Mining”, Aug 19, 2021, <https://www.thomasnet.com/insights/companies-are-preparing-for-space-mining/>, accessed 1/10/21, sb

When LA-based blues and rock band Canned Heat wrote “Poor Moon” in the same year Neil Armstrong took his famous giant leap, their lyrics reflected the Cold-War-era concern that spacefaring nations would one day scar the moon by testing a bomb on its surface. While this, thankfully, hasn’t yet happened, the moon — along with all the other planets, moons, and asteroids in the solar system — could one day be mined for resources to meet Earth’s ever-growing needs. Why Mine Off-Earth? Space Exploration Is Expensive While the price tag involved in establishing a human colony on the Moon or Mars is mind-boggling, the costs of sustaining off-Earth colonies and keeping them resupplied indefinitely are even more so — unless the settlements can somehow pay for themselves. Mining for much-needed metals and sending them back to Earth could change the game for space exploration, transforming off-world ventures from prohibitively expensive to financially viable. That being said, bringing a heavy payload of minerals down through Earth’s atmosphere is not currently feasible. Futurists believe that instead, minerals mined in space will be used in space as humanity spreads outwards. Rare Earth Materials Are Abundant There are around two million near-earth asteroids brimming with rare earth minerals, precious metals, iron, and nickel. The Moon contains helium-3, yttrium, samarium, and lanthanum, while Mars contains an abundance of magnesium, aluminum, titanium, iron, chromium, and trace amounts of lithium, cobalt, tungsten, and other metals. Importantly, many planetary bodies contain water, which through hydrolysis can be used as rocket fuel. It Helps with Sustainability Earth’s resources are finite. Non-renewable metal resources are inherently unsustainable, and mining causes environmental degradation all over the world. The answer is to source our minerals off-world. Off-world minerals are exhaustible as well, but the argument is that mining lifeless rocks such as the Moon or asteroids is infinitely preferable to continuing to damage Earth’s fragile biosphere. Discoveries May Be Made Opening space to commercial mining does not mean that science takes a back seat. Space-mining interests could drive scientific advancement by discovering extremely rare or unknown minerals on other planetary bodies. Robotics Would Do the Work While countless lives have been lost on Earth over the centuries due to mining accidents and disasters, it is likely that humans will not have to risk their lives by traveling in-person to off-world mining sites. Regolith-sampling probes are already in use and provide an early glimpse of what a scaled-up robotic mining craft may one day look like. Off-Earth Mining and Space Law The 1967 Outer Space Treaty is unclear in terms of whether any country — or private company — can claim mineral rights in space. It states that “exploration and use of outer space shall be carried out for the benefit and in the interests of all countries and shall be the province of all mankind.” The 1979 Moon Treaty was an attempt to declare the Moon and its natural resources to be CHM (Common Heritage of Mankind). Significantly, it called for “an equitable sharing [by all countries] in the benefits derived from these resources.” Most nations, including the U.S., did not ratify this treaty. Recently, the U.S. has accelerated its efforts to create a legal framework for the exploitation of resources in space. The Obama administration signed the U.S. Commercial Space Launch Competitiveness Act of 2015, allowing U.S. citizens to “engage in the commercial exploration and exploitation of space resources.” In April 2020, the Trump administration issued an executive order supporting U.S. mining on the Moon and asteroids. In May 2020, NASA unveiled the Artemis Accords, which included the development of safety zones around lunar mining sites. Former NASA administrator Jim Bridenstine said: “It’s time to establish the regulatory certainty to extract and trade space resources,” and clarified in a separate statement that: “We do believe we can extract and utilize the resources of the moon, just as we can extract and utilize tuna from the ocean.” NASA planned an Asteroid Redirect Mission which involved collecting a multi-ton boulder from an asteroid and redirecting it into a stable orbit around the moon, but the mission was canceled in 2017. What Companies Are Preparing for a Future of Space Mining? One thing that is becoming clear is that off-earth mining is unlikely to be a state-run activity. Instead, several private companies are jockeying to be first in line to access minerals in space. iSpace (Japan) has a mission to “help companies access new business opportunities on the moon,” including the extraction of water and mineral resources to spearhead a space-based economy. Planetary Resources (defunct) was founded in 2009 with the goal of developing a robotic asteroid mining industry. Despite having high-profile founding investors including Alphabet’s Larry Page, Eric Schmidt, and Virgin Group founder Richard Branson, Planetary ran into financial trouble in 2018 and was gone by 2020. Deep Space Industries (defunct) was another early mover that intended to explore, examine, sample, and harvest minerals from asteroids. DSI was acquired by Bradford Space in 2019. Offworld is an AI company building “universal industrial robots to do the heavy lifting [including mining] on Earth, the Moon, asteroids, and Mars.” The Asteroid Mining Corporation (UK) is a venture currently crowdfunding for a 2023 satellite mission called “El Dorado,” which will conduct a spectral survey of 5,000 asteroids to identify the most valuable for mining. Alongside the U.S., the tiny European nation of Luxembourg has also developed a space mining framework and has subsequently emerged as a European hub for the fledgling industry.

#### Asteroid mining solves climate change, resource shortages, and environmental degradation – independently its key to space habitation that solves every existential crisis

Hlimi 14 [Tina Hlimi, Canadian lawyer with a Bachelors and Masters Degrees in Environmental Sciences from McGill University, 2014, “THE NEXT FRONTIER: AN OVERVIEW OF THE LEGAL AND ENVIRONMENTAL IMPLICATIONS OF NEAR-EARTH ASTEROID MINING,” ANNALS OF AIR AND SPACE LAW, https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=2546924]/Kankee

A. THE ENVIRONMENTAL BENEFITS OF NEAR EARTH ASTEROID HARVESTING Let us recapitulate what we have already found. Shortage of resources is not a fact; it is an illusion born of ignorance. Scientifically and technically feasible improvements in launch vehicles will make departure from Earth easy and inexpensive. Once we have a foothold in space, the mass of the asteroid belt will be at our disposal, permitting us to provide for the material needs of a million times as many people as Earth can hold. Solar power can provide all the energy needs of this vast civilisation (10,000,000 billion people) from now until the Sun expires. Using less than one percent of the helium-3 energy resources of Uranus and Neptune for fusion propulsion, we could send a billion interstellar arks, each containing a billion people, to the stars. There are about a billion Sun-like stars in our galaxy. We have the resources to colonise the entire Milky Way. 122 In addition to demystifying the legal doctrine governing outer space natural resource appropriation it is also necessary to weigh the benefits and detriments of space-faring activities. Foremost, States around the world are developing at unprecedented rates and the human population is mounting in conjunction with demand for natural resources to sustain the current and newly established western standard of living. One of the fastest growing nations, China, is experiencing unhindered growth facilitated by fossil fuel use from coal and extensive mining. This has caused substantial water, soil and air degradation. In the face of these troubles, NEA mining could be the key to preserving the Earth's bounty and replenishing contaminated water supplies. The influx of natural resources could thwart the burning of dirty coal and fossil fuels, thereby mitigating the effects of climate change, such as, rising sea level, atmospheric pollution, melting of sea ice and rising temperatures. NEA harvesting could also protect the ocean and the fragile and largely unexplored deep seabeds 123 from oil and gas drilling. It could furthermore protect ecosystems from rare-earth mineral mining predominantly used to fuel the electronics sector. 124 NEA mining is especially pertinent as China restricted its global exports of rare-earth minerals in 2009, incongruously citing the need to protect the environment. Unfortunately, the supply cuts have forced dependent States like Japan, the United States and South Korea to heighten rare-Earth mineral exploration. This accordingly led to Japan's 2011 discovery of rare-earth minerals in the ocean-bed deposits of the Pacific Exclusive Economic Zone (PEEZ) thereby necessitating risky, deep-sea mining techniques, which may result in marine pollution if not carefully designed and developed. Other States, which have joined the environmentally destructive rare-earth mineral exploration movement include India, Canada, Tanzania, Australia, Brazil and Vietnam., There is accordingly much competition and exploration for rare-earth minerals which could result in significant exploitation of untouched areas like the PEEZ seabed and Mongolia.125 Other regions which may soon be targeted for mineral and hydrological resources include Antarctica and the Arctic. With the advent of technological advances, environmentally destructive practices such as refining may soon occur in outer space, sparing the Earth of pollution. 126 Accordingly, NEA mining is a viable technology for preserving the Earth's environment by curbing atmospheric and marine pollution, enhancing water supply and quality and mitigating the effects of climate change; all while allowing humankind to maintain and even improve their standard of living through increased technologies, consumption and population growth. B. THE ENVIRONMENTAL CONSEQUENCES OF NEAR EARTH ASTEROID MINING

#### Human Extinction is inevitable if we don’t explore and inhabit space – multiple scenarios

Austen, 2011

Ben Austen, contributing editor of Harper’s Magazine, “After Earth: Why, Where, How, and When We Might Leave Our Home Planet,” popular science, http://www.popsci.com/science/article/2011-02/after-earth-why-where-how-and-when-we-might-leave-our-home-planet?page=3]

Earth won’t always be fit for occupation. We know that in two billion years or so, an expanding sun will boil away our oceans, leaving our home in the universe uninhabitable—unless, that is, we haven’t already been wiped out by the Andromeda galaxy, which is on a multibillion-year collision course with our Milky Way. Moreover, at least a third of the thousand mile-wide asteroids that hurtle across our orbital path will eventually crash into us, at a rate of about one every 300,000 years. Why? Indeed, in 1989 a far smaller asteroid, the impact of which would still have been equivalent in force to 1,000 nuclear bombs, crossed our orbit just six hours after Earth had passed. A recent report by the Lifeboat Foundation, whose hundreds of researchers track a dozen different existential risks to humanity, likens that one-in-300,000 chance of a catastrophic strike to a game of Russian roulette: “If we keep pulling the trigger long enough we’ll blow our head off, and there’s no guarantee it won’t be the next pull.” Many of the threats that might lead us to consider off-Earth living arrangements are actually man-made, and not necessarily in the distant future. The amount we consume each year already far outstrips what our planet can sustain, and the World Wildlife Fund estimates that by 2030 we will be consuming two planets’ worth of natural resources annually. The Center for Research on the Epidemiology of Disasters, an international humanitarian organization, reports that the onslaught of droughts, earthquakes, epic rains and floods over the past decade is triple the number from the 1980s and nearly 54 times that of 1901, when this data was first collected. Some scenarios have climate change leading to severe water shortages, the submersion of coastal areas, and widespread famine. Additionally, the world could end by way of deadly pathogen, nuclear war or, as the Lifeboat Foundation warns, the “misuse of increasingly powerful technologies.” Given the risks humans pose to the planet, we might also someday leave Earth simply to conserve it, with our planet becoming a kind of nature sanctuary that we visit now and again, as we might Yosemite. None of the threats we face are especially far-fetched. Climate change is already a major factor in human affairs, for instance, and our planet has undergone at least one previous mass extinction as a result of asteroid impact. “The dinosaurs died out because they were too stupid to build an adequate spacefaring civilization,” says Tihamer Toth-Fejel, a research engineer at the Advanced Information Systems division of defense contractor General Dynamics and one of 85 members of the Lifeboat Foundation’s space-settlement board. “So far, the difference between us and them is barely measurable.” The Alliance to Rescue Civilization, a project started by New York University chemist Robert Shapiro, contends that the inevitability of any of several cataclysmic events means that we must prepare a copy of our civilization and move it into outer space and out of harm’s way—a backup of our cultural achievements and traditions. In 2005, then–NASA administrator Michael Griffin described the aims of the national space program in similar terms. “If we humans want to survive for hundreds of thousands or millions of years, we must ultimately populate other planets,” he said. “One day, I don’t know when that day is, but there will be more human beings who live off the Earth than on it.”

### 3

#### Asteroid mining solves mineral shortages, resource conflicts and fallout from terrestrial mining

Kevin MacWhorter 16, J.D. Candidate, William & Mary Law School, "Sustainable Mining: Incentivizing Asteroid Mining in the Name of Environmentalism", William & Mary Environmental Law and Policy Review, Vol 40, Issue 2, Article 11, https://scholarship.law.wm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1653&context=wmelpr

A. Rare Element Mining on Earth

In the next sixty years, scientists predict that certain elements crucial to modern industry such as platinum, zinc, copper, phosphorous, lead, gold, and indium could be exhausted on Earth. 12 Many of these have no synthetic alternative, unlike chemical elements such as oil or diamonds.13 Liquid-crystal display (LCD) televisions, cellphones, and laptops are among the various consumer technologies that use precious metals.14Further, green technologies including wind turbines, solar panels, and catalytic converters require these rare elements. 15 As demand rises for both types of technologies, and as reserves of rare metals fall, prices skyrocket.16 Demand for nonrenewable resources creates conflict, and consumerism in rich countries results in harsh labor treatment for poorer countries.17 In general, the mining industry is extremely destructive to Earth’s environment.18 In fact, depending on the method employed, mining can destroy entire ecosystems by polluting water sources and contributing to deforestation.19 It is by its nature an unsustainable practice, because it involves the extraction of a finite and non-renewable resource.20 Moreover, by extracting tiny amounts of metals from relatively large quantities of ore, the mining industry contributes the largest portion of solid wastes in the world.21 The Environmental Protection Agency (EPA) describes the industry as the source of more toxic and hazardous waste than any other industrial sector [in the United States], costing billions of dollars to address the public health and environmental threats to communities. 22 Poor regulations and oxymoronic corporate definitions of sustainability, however, make it unclear as to just how much waste the industry actually produces.23 Platinum provides an excellent case study of the issue, because it is an extremely rare and expensive metal—an ore expected to exist in vast quantities in asteroids.24 Further, production of platinum has increased sharply in the past sixty years in order to keep up with growing demand for use in new technologies.25 In fact, despite their high costs, platinum group metals are so useful that [one] of [four] industrial goods on Earth require them in production. 26 Scholars do not expect demand to slow any time soon.27 Among other technologies, industries use platinum in products such as catalytic converters, jewelry production, various catalysts for chemical processing, and hydrogen fuel cells.28 While there is no consensus on how far the Earth’s reserves of platinum will take humanity, many scientists agree that platinum ore reserves will deplete in a relatively short amount of time.29 With the rate of mining at an all-time high,30 it is increasingly clear that historical patterns of mineral resources and development cannot simply be assumed to continue unaltered into the future. 31 The platinum mining industry, however, has a strong incentive to increase its rate of extraction as profits grow with the rate of demand. Without any alternative, this destructive practice will continue into the future.32 So-called platinum-group metal (PGM) ores are mined through underground or open cut techniques.33 Due to these practices, all but a very small fraction of the mined platinum ore is disposed of as solid waste.34 The environmental consequences of platinum production are thus quite significant, but like the mining industry in general, the amount of waste is typically under-reported.35 While this is due to high production levels at the moment, those levels will only increase given the estimated future demand of platinum.36 In spite of the negative consequences, mining continues unabated because it is economically important to many areas.37 The future environmental costs provide a major challenge in creating a sustainable system. Relegating at least some mining companies to near-Earth asteroids would reduce the negative effects of future mining levels on Earth. The economic benefits of mining need not be sacrificed for the sake of the environment.38

#### Earth mining kills the environment

Matthew S. Williams 19, writer at Universe Today, Aug 1 2019, "Asteroid Mining: What Will It Involve and Is This the Future of Wealth?", Interessting Engineering, https://interestingengineering.com/asteroid-mining-what-will-it-involve-and-is-this-the-future-of-wealth

Of course, this raises the obvious question: wouldn't it be really expensive to do all this mining? Why not simply continue to rely on Earth for sources of precious metals and resources and simply learn to use them better? To put it simply, we are running out of resources. To be clear, learning to use our resources better and more sustainably is always a great idea. And while it is certainly true than Earth-based mining is far cheaper than going to space would be, that may not be the case indefinitely. Aside from the fact that off-world minerals and ices would be of considerable value to Earth's economy, there is also the way that growing consumption is leading our reserves to become slowly exhausted. In fact, according to some estimates, it is possible that our planet will run out of key elements that are needed for modern industry and food production within the next 50 to 60 years. This alone is a pretty good incentive to tap the virtually inexhaustible supply of elements located off-world. Plus, there are a lot of benefits to expanding humanity's resource base beyond Earth. Here on Earth, mining takes a considerable toll on the natural environment. In fact, depending on the methods used, it can result in erosion, sinkholes, habitat destruction, and the destruction of native animal and plant life. There's also the dangers of toxic runoff and the contamination of soil, groundwater, and surface water, which is a danger to humans, as well as to wildlife and the natural environment. As for smelting, machining, and manufacturing, the environmental damage that results is well-documented. Combined with power generation, these industrial processes are one of the leading contributors to air, water, and pollution. By shifting these burdens off-world, humanity could dramatically-reduce the impact it has on the natural environment.

#### Biod loss causes human extinction

Joe McCarthy 18, a Staff Writer at Global Citizen, Nov 8 2018, "Humans Could Face Extinction if We Don't Protect Biodiversity: UN", Global Citizen, <https://www.globalcitizen.org/en/content/biodiversity-loss-human-extinction/>

As the sixth mass extinction event accelerates around the world, engulfing thousands of animal and plant species, humans risk facing a similar fate unless drastic interventions are made, according to Cristiana Pașca Palmer, the United Nations biodiversity chief, who recently spoke with the Guardian. Palmer said that within the next two years, countries have to develop an ambitious plan to conserve land, protect animals, and stop practices that are harming wildlife. This effort is equally as urgent as the Paris climate agreement’s goal of mitigating climate change, she said. “The loss of biodiversity is a silent killer,” she told the Guardian. “It’s different from climate change, where people feel the impact in everyday life. With biodiversity, it is not so clear but by the time you feel what is happening, it may be too late.” Next month, countries will meet in Sharm el Sheikh, Egypt, to begin mapping out what such a plan would like. Palmer hopes that a final version will be formalized in Beijing in 2020. If a binding global treaty fails to materialize, then humanity faces an uncertain future, she said. Past efforts to stop the loss of biodiversity have not proved successful, according to the Guardian. In recent years, evidence of this staggering loss has begun accumulating. Wild animal populations have declined by 60% since 1970, more than 26,000 plants and animals are close to extinction, nearly two-thirds of the world’s wetlands and half of all rainforests have been destroyed, more than 87% of the world’s ocean area is dying, and the planet needs an estimated 5 million years to recover from the biodiversity loss it has already sustained. “We are sleepwalking towards the edge of a cliff,” Mike Barrett, executive director of science and conservation at WWF, recently told the Guardian. “If there was a 60% decline in the human population, that would be equivalent to emptying North America, South America, Africa, Europe, China, and Oceania. That is the scale of what we have done.” “This is far more than just being about losing the wonders of nature, desperately sad though that is,” he said. “This is actually now jeopardising the future of people. Nature is not a ‘nice to have’ — it is our life-support system.” The benefits of biodiversity are hard to overstate. The food chain, climate systems, atmospheric conditions, natural resources, and much more depend on the delicately structured interactions of ecosystems around the world. The truly wild places in the world, meanwhile, are crucial to generating, cleaning, and distributing water around the world, and could help to mitigate the looming water crisis. These landscapes and marine environments also clean the air and act as carbon sinks, stabilize the global environment, and protect countries from natural disasters. In addition to climate change, the biggest threats to biodiversity are deforestation, agriculture, over-development, and industrial pollution. While Palmer sounded an urgent alarm bell while speaking with the Guardian, she’s hopeful that countries will recognize the threat of biodiversity loss and begin to take action. The UN is calling for at least 30% of all land and 15% of all marine environments to be protected by 2030 and for targets to be lifted in the following years. “Things are moving. There is a lot of goodwill,” Palmer said. “We should be aware of the dangers but not paralysed by inaction. It’s still in our hands but the window for action is narrowing. We need higher levels of political and citizen will to support nature.”

### Case

#### No space war – ingrained normative frameworks, attributability, and space debris prevent escalation

Pavur and Martinovic 19 [James Pavur, DPhil Researcher Cybersecurity Centre for Doctoral Training Oxford University, Ivan Martinovic, Professor of Computer Science Department of Computer Science Oxford University, “The Cyber-ASAT: On the Impact of Cyber Weapons in Outer Space,” 2019 11th International Conference on Cyber Conflict: Silent Battle, <https://ccdcoe.org/uploads/2019/06/Art_12_The-Cyber-ASAT.pdf>]

STABILITY IN SPACE Given the uncomfortable combination of high dependency and low survivability, one might expect to observe frequent attacks against critical military assets in orbit. However, **despite decades of recurring prophesies of impending space war, no such conflict has broken out** [14]–[18]. It is true that a handful of space security crises have occurred; most notably, the 2007 Chinese anti-satellite weapon (ASAT) test and the 2008 US ASAT demonstration in response [19]. Moreover, a recent Centre for Strategic and International Studies report suggests increasing interest in attacking US space assets, particularly among the Chinese, Russian, North Korean and Iranian militaries [20]. Overall, however, the space domain has remained puzzlingly peaceful. In this section, we outline three major contributors to this enduring stability: limited accessibility, attributable norms, and environmental interdependence. A. Limited Accessibility Space is difficult. Over 60 years have passed since the first Sputnik launch and only nine countries (ten including the EU) have orbital launch capabilities. Moreover, a launch programme alone does not guarantee the resources and precision required to operate a meaningful ASAT capability. Given this, one possible reason why space wars have not broken out is simply because only the US has ever had the ability to fight one [21, p. 402], [22, pp. 419–420]. Although launch technology may become cheaper and easier, it is unclear to what extent these advances will be distributed among presently non-spacefaring nations. Limited access to orbit necessarily reduces the scenarios which could plausibly escalate to ASAT usage. Only major conflicts between the handful of states with ‘space club’ membership could be considered possible flashpoints. Even then, the fragility of an attacker’s own space assets creates de-escalatory pressures due to the deterrent effect of retaliation. Since the earliest days of the space race, dominant powers have recognized this dynamic and demonstrated an inclination towards de-escalatory space strategies [23]. B. Attributable Norms There also exists a long-standing normative framework favouring the peaceful use of space. The effectiveness of this regime, centred around the Outer Space Treaty (OST), is highly contentious and many have pointed out its serious legal and political shortcomings [24]–[26]. **Nevertheless, this status quo framework has somehow supported over six decades of relative peace in orbit.** Over these six decades, norms have become deeply ingrained into the way states describe and perceive space weaponization. This de facto codification was dramatically demonstrated in 2005 when the US found itself on the short end of a 160-1 UN vote after opposing a non-binding resolution on space weaponization. **Although states have occasionally pushed the boundaries of these norms, this has typically occurred through incremental legal re-interpretation rather than outright opposition** [27]. Even the most notable incidents, such as the 2007-2008 US and Chinese ASAT demonstrations, were couched in rhetoric from both the norm violators and defenders, depicting space as a peaceful global commons [27, p. 56]. Altogether, this suggests that **states perceive real costs to breaking this normative tradition and may even moderate their behaviours accordingly.** One further factor supporting this norms regime is the high degree of attributability surrounding ASAT weapons. For **kinetic ASAT technology, plausible deniability and stealth are essentially impossible**. The literally explosive act of launching a rocket cannot evade detection and, if used offensively, retaliation. **This imposes high diplomatic costs on ASAT usage and testing**, particularly during peacetime. C. Environmental Interdependence A third stabilizing force relates to the orbital debris consequences of ASATs. China’s 2007 ASAT demonstration was the largest debris-generating event in history, as the targeted satellite dissipated into thousands of dangerous debris particles [28, p. 4]. Since debris particles are indiscriminate and unpredictable, they often threaten the attacker’s own space assets [22, p. 420]. This is compounded by Kessler syndrome, a phenomenon whereby orbital debris ‘breeds’ as large pieces of debris collide and disintegrate. As space debris remains in orbit for hundreds of years, the cascade effect of an ASAT attack can constrain the attacker’s long-term use of space [29, pp. 295– 296]. Any state with kinetic ASAT capabilities will likely also operate satellites of its own, and they are necessarily exposed to this collateral damage threat. **Space debris thus acts as a strong strategic deterrent to ASAT usage.**

#### Alt cause - The Kessler syndrome is starting now but private megaconstellations make management impossible

Boley and Byers 21, Aaron C. Boley is an associate professor and Canada Research Chair in Planetary Astronomy in the Department of Physics and Astronomy, Faculty of Science, at The University of British Columbia. I am also the co-director of The Outer Space Institute, a transdisciplinary organization that addresses challenges associated with NewSpace. Michael Byers holds the Canada Research Chair in Global Politics and International Law. His work focuses on Outer Space, Arctic sovereignty, climate change, the law of the sea, the laws of war, and Canadian foreign and defence policy. Dr. Byers has been a Fellow of Jesus College, Oxford University, a Professor of Law at Duke University, and a Visiting Professor at the universities of Cape Town, Tel Aviv, Nord (Norway) and Novosibirsk (Russia). Aaron C. Boley & Michael Byers, “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth”, Scientific Reports volume 11, Article number: 10642 (2021), 20 May 2021, <https://www.nature.com/articles/s41598-021-89909-7.pdf>, accessed 12/1/21, sb

Thousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3. There are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraft and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4. The addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5,6,7,8. Results The overall setting The rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defines NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with effects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph. Although the volume of space is large, individual satellites and satellite systems have specific functions, with associated altitudes and inclinations (Fig. 2). This increases congestion and requires active management for station keeping and collision avoidance9, with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, after failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency. When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. The satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under different national regulatory regimes, are soon likely to follow. Enhanced collision risk Mega-constellations are composed of mass-produced satellites with few backup systems. This consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difficult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC (see “Methods”). The large density spikes show that some shells will have satellite number densities in excess of n=10−6 km−3. Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-than-fully transparent about events13 in LEO. Despite the congestion and traffic management challenges, FCC filings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the filings do not account for untracked debris6, including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 after one year. Thus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur. Fragmentation events are not confined to their local orbits, either. The India 2019 ASAT test was conducted at an altitude below 300 km in an effort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could affect all operators in LEO. Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation. One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

#### Low altitude orbits zeroes risk of collision and doesn’t contribute to overall debris in dense areas – even if satellites fail no impact

Grush 18 – [Loren, “SpaceX wants to fly some internet satellites closer to Earth to cut down on space trash,” 10/9/2018, <https://www.theverge.com/2018/11/9/18016962/spacex-internet-satellites-space-debris-trash-orbit-closer-earth-distance-atmosphere>]

SpaceX is revising its satellite internet initiative, Starlink, and it now hopes to operate some of its spacecraft at a lower altitude than originally planned. In a new filing to the Federal Communications Commission (FCC), SpaceX is asking the agency to modify its license so that more than 1,500 Starlink satellites can operate at an altitude 600 kilometers lower than the company originally requested.

SpaceX argues that this change will make the space environment safer, as it will be easier to get rid of these satellites at this new altitude when they run low on fuel or can no longer function properly in orbit. This update could also explain the unexpected behavior of two of SpaceX’s test satellites for Starlink, which have remained in lower orbits than expected.

Back in March, the FCC approved SpaceX’s license for the first phase of its ambitious Starlink initiative — the company’s long-term plan to launch nearly 12,000 satellites into orbit to beam internet coverage down to Earth. Initially, SpaceX asked the FCC for permission to launch 4,425 satellites into orbits ranging between 1,110 to 1,325 kilometers high. But with this new filing, SpaceX is requesting that 1,584 of those satellites, which were supposed to operate at 1,110 kilometers, be allowed to operate at 550 kilometers instead.

SpaceX says moving the satellites to a lower altitude means it can do more with less. Originally, the company said it needed 1,600 satellites to operate at the 1,110-kilometer altitude, but moving them lower means the company can get the same results with 16 fewer spacecraft. And the lower altitude makes it easy to dispose of these satellites once they’re done in space. At this height, particles from Earth’s atmosphere bombard the spacecraft more rapidly, pushing them out of orbit and dragging them down to the planet. And on the way down, they burn up in the atmosphere.

Making sure these spacecraft come out of orbit in a timely manner is crucial because of the vast number of vehicles that SpaceX wants to put into orbit. A constellation the size of Starlink could dramatically increase the number of operational satellites in space, raising the risk of in-space collisions. A recent NASA study argued that 99 percent of these satellites will need to be taken out of orbit, reliably, within five years of launch, or the risk of satellite collisions goes up quite a bit.

De-orbiting a satellite typically entails bringing the vehicle to a low enough altitude with thrusters where Earth’s air particles and gravity drag the probe down so that it burns up. Now, with this new filing, SpaceX won’t have to significantly move 1,584 of its satellites to get rid of them. The atmosphere at 550 kilometers should do the job within a few years. That’s also helpful in case the spacecraft fails in orbit. Satellites that fail in higher altitudes could turn into unoperational space debris that stay in orbit for long periods of time. At lower altitudes, they can still fail, and the atmosphere will still swallow them up in a timely manner.

#### Space debris creates existential deterrence and a taboo

Bowen 18 [(Bleddyn, lecturer in International Relations at the University of Leicester) “The Art of Space Deterrence,” European Leadership Network, February 20, 2018, <https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/>] TDI

Fourth, the ubiquity of space infrastructure and the fragility of the space environment may create a degree of existential deterrence. As space is so useful to modern economies and military forces, a large-scale disruption of space infrastructure may be so intuitively escalatory to decision-makers that there may be a natural caution against a wholesale assault on a state’s entire space capabilities because the consequences of doing so approach the mentalities of total war, or nuclear responses if a society begins tearing itself apart because of the collapse of optimised energy grids and just-in-time supply chains. In addition, the problem of space debris and the [political-legal hurdles to conducting debris clean-up](https://doi.org/10.1080/14777622.2014.890489) operations mean that even a handful of explosive events in space can render a region of Earth orbit unusable for everyone. This could caution a country like China from excessive kinetic intercept missions because its own military and economy is increasingly reliant on outer space, but perhaps not a country like North Korea which does not rely on space. The usefulness, sensitivity, and fragility of space may have some existential deterrent effect. [China’s catastrophic anti-satellite weapons test in 2007](https://defenceindepth.co/2017/01/11/chinas-space-weapons-test-ten-years-on-behemoth-pulls-the-peasants-plough/) is a valuable lesson for all on the potentially devastating effect of kinetic warfare in orbit.

#### No one’s going to war over a downed satellite

Bowen 18 [Bleddyn Bowen, Lecturer in International Relations at the University of Leicester. The Art of Space Deterrence. February 20, 2018. https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/]

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.