9 Space Security Cooperation: Changing Dynamics

Jessica L. West

Contents

Abstract

The security of outer space is a cooperative endeavor to achieve a shared benefit. Yet, while cooperation is essential for space security, it is often fraught. This chapter examines the logic for cooperation as an approach to space security, including supportive governance mechanisms, and traces the impetus and evolution of such efforts over time, marked by struggle to overcome strategic competition. Increasingly, competition is giving way to new patterns of cooperation focused on military alliances and new strategic interests. In this context, it is not clear that cooperation will be maintained as a core value and principle of space activities.

J. L. West (✉)
Project Ploughshares, Waterloo, ON, Canada
e-mail: jwest@ploughshares.ca

K.-U. Schrogl (ed.), *Handbook of Space Security*,
https://doi.org/10.1007/978-3-030-23210-8_123

Introduction

The security of outer space is focused on the security and sustainability of outer space as a global environment that can be used safely by all, rather than the narrow interests of individual actors. At heart, this is a cooperative endeavor to achieve a shared benefit. Yet, while cooperation is both an individual and collective interest, it is rarely straightforward. Like geopolitical relationships on Earth, outer space is subject to not only cooperative impulses, but also competition, self-interest, power disparities, and fear. Sustaining the security of the outer space environment thus involves extensive coordination, but like a dance, it is also marked by missteps.

This chapter begins by examining the logic for international cooperation as an approach to space security, including supportive governance mechanisms. It then traces the impetus and evolution of cooperative efforts in outer space from technical coordination at the dawn of the space age, through large-scale exploration efforts symbolized by the International Space Station (ISS), capacity-building, and contemporary governance initiatives aimed at safety and sustainability. It is clear that international cooperation is a core value and pursuit of national space activities, and over time it has both widened and deepened. Yet, cooperation is at times stymied by competing values, particularly concerns for national security in outer space, reflecting the ups and downs of broader geopolitical relations and tensions. But cooperation is not merely a reflection of politics. As a mode of governing the security of outer space, cooperative relationships and practices contribute to trust, transparency, and interdependencies capable of transcending political pressures elsewhere.

Space security cooperation has thus been marked by an ongoing struggle to overcome strategic competition. Recently, however, such competition is giving way to new patterns of cooperation. Focused on national security *in* outer space rather than the security *of* outer space, the expansion of military alliances and security partnerships into the space domain – increasingly viewed as one of warfare – raises questions about the strategic stability of the outer space environment and the implications for collective wellbeing in outer space. Looking forward, the chapter also considers how heightened geopolitical competition and shifting strategic interests in outer space might influence emerging activities in outer space including lunar and human space exploration and possible resource extraction.

Cooperation is an essential and persistent feature of activities in outer space and necessary to achieve the long-term security of the outer space environment. But such cooperation is also fraught, striving, and sometimes failing to overcome strategic competition. As the nature of this competition changes alongside new actors and ventures, the continued value placed on cooperation is at risk of diminishing.

The Case for Cooperative Approaches to Space Security

The 1967 Outer Space Treaty recognizes the "common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes" (OST). But like all global commons, the use of outer space is subject to competing – even conflicting – interests. The natural resources of outer space, such as radiofrequency and orbital positions are limited and shared. The environment is fragile and vulnerable to contamination from the accumulation of debris. Growing use of outer space means that it is becoming more congested, especially in popular orbits where, in the next five years alone, the number of satellites in low Earth orbit (LEO) could grow tenfold if proposals for large-scale constellations advance. As a shared environment, threats to safety, security, and sustainability – be they manmade contamination and interference, or natural hazards such as space weather – are mutually harmful.

Despite the declaration of outer space as a province of all mankind, it is also a place of inequality. Long a domain of the powerful, technology and cost barriers limit both access to and use of space and by extension, the tremendous benefits that it supports including remarkable tools for communication, navigation, and vast data collection enabled by Earth observation. And while threats within the space environment are indiscriminate, the ability to mitigate harm is not equally shared.

Outer space is also a place of strategic competition and tensions. Initially marked by existential competition for military, scientific, technological, and economic supremacy exemplified by the space race, today the strategic use of outer space has evolved into dependency and intense military vulnerability.

From a governance perspective, outer space is thus inherently vulnerable to numerous challenges including a tragedy of the commons, persistent inequality, and security dilemmas. It is a place of mutual interests, but also competition, suspicion, and fear.

The concept of space security is a response to these challenges. Defined here as the "secure, and sustainable access to and use of space, and freedom from space-based threats" (West 2019), this approach to space security promotes a secure and sustainable space environment to assure safe and responsible access to and use for all, as promoted in the 1967 Outer Space Treaty. Reflecting a collective approach to the security of – and in – a global commons, the security of outer space depends on international cooperation.

Along with peaceful purposes, such cooperation is the bedrock of the international governance framework for outer space. Institutionally, the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) is the focal point of cooperation. Spurred by the confluence of scientific and military interests in outer space alongside Cold War competition, the Committee was established in 1959 by UN Resolution 1472 (XIV) "International cooperation in the peaceful uses of outer space." Core to its mandate is to facilitate information exchange related to outer space activities, and to promote and support international cooperation as a means to expand the peaceful use of outer space and to avoid extending national rivalries into this domain. Today, with 92 Member States and growing, it maintains a prominent role in the governance of outer space.

International cooperation is also a key principle of space activities enshrined in the 1967 Outer Space Treaty, which, in addition to the United Nations Charter, provides the fundamental basis for legal order in outer space. Specifically, Article III of the treaty mandates that states pursue outer space activities "…in the interest of maintaining international peace and security and promoting international co-operation and understanding" (1967).

Cooperation in outer space is thus essential, mandated, but often fraught. Security in and of outer space, where threats and vulnerabilities are shared and individual actions have collective consequences, mean that there is clearly a mutual benefit to cooperation. But fostering this cooperation requires overcoming strategic rivalry, national security concerns, and competing interests. Efforts to navigate these tensions in pursuit of shared safety, security, and sustainability benefits in outer space have been ongoing since the early days of space activities, built largely on the basis of technical and utilitarian modes of cooperation.

Moderating Strategic Rivalry: Technical and Utilitarian Modes of Cooperation

The first space age is synonymous with the existential competition of the space race. But even amid deep, strategic rivalry, there were efforts to temper competition with cooperative impulses. The promise of cooperation was held out by U.S. President John F. Kennedy in his inaugural address where he declared "Let both sides seek to invoke the wonders of science instead of its terrors. Together let us explore the stars" (1961). Concretely, following his landmark declaration that the United States would land a man on the Moon within the decade, Kennedy is reported to have reached out to the Soviet Union on several occasions to foster cooperation (Kay 1998). However, terror ultimately overwhelmed cooperation. At a time of heated nuclear confrontation, Soviet reciprocity was foregone in favor of focused attention to the negotiation of a nuclear test ban treaty; later it was stymied by Kennedy's death.

Cooperation was nonetheless established on more technical areas. A 1962 agreement facilitated cooperation in the exchange of weather data and the launching of meteorological satellites, as well as efforts to map the geomagnetic field of Earth, and in the experimental relay of satellite communications (Sagdeev and Eisenhower 2008). Such functional approaches to cooperation in outer space remain a core feature today, having evolved into what are considered global utilities. This includes the sharing of meteorological and climate data, open access to and interoperability of civilian positioning, navigation and timing services, and the increasing public availability of Earth observation (EO) data.

This coordination and sharing of data and services has been formalized through organizations such as the International Committee on Global Navigation Satellite Systems (ICG) established in 2005 under the umbrella of the United Nations to facilitate compatibility, interoperability, and transparency between systems. The Coordination Group for Meteorological Satellites provides a forum for the exchange of technical information on geostationary and polar-orbiting meteorological satellite systems. Collected data is made available to the World Meteorological Organization, which distributes it to more than 3,000 weather-forecast outlets in 187 member states and 6 territories. Efforts to share and expand access to Earth observation data include the Committee on Earth Observation Satellites, which has 62 member agencies from around the world that work to coordinate and harmonize civil EO programs and data exchange from 170 satellites. Similarly, there is an international effort to create a Global Earth Observation System of Systems (GEOSS) that includes government agencies, academia, and the private sector, to enhance the sharing and integration of EO data worldwide. States also cooperate extensively for the use of satellite data to support disaster response and search and rescue through programs such as the International Charter on Space and Major Disasters and the Cospas-Sarsat international satellite system for search and rescue.

Such cooperation contributes to space security by providing essential global services that not only enrich lives, but also save them. This is the primary way in which most people on Earth access and enjoy the benefits of outer space. And, like in the early days of the space age, it remains critical to fostering cooperative relationships and reciprocity across diverse space actors. Indeed, on this basis of narrow, technical cooperation, cooperative relationships in outer space have extended much further, encompassing space exploration as both a practical and symbolic endeavor bridging self-interest and shared goals.

From Practical to Symbolic: Cooperation in Space Exploration

Exploration beyond Earth is at the heart of efforts to access outer space. And perhaps more so than any other activity, exploration bridges the enduring tension between national interest and collective aspiration in outer space. This was evident with the landing of the Apollo 11 mission on the Moon in 1969, which marked both a national achievement and an historic moment for all of humanity. The astronaut remains an enduring symbol of such unity. Taking their place among national icons, astronauts are also global figures, assigned a special status as "envoys of mankind in outer space" under the Article V of the Outer Space Treaty, which affords them the right for assistance, rescue, and return by all states.

Indeed, despite the competitive nature of space activities during the Cold War, the pursuit of space exploration gradually enabled a critical precedent of cooperation, starting with the 1975 Apollo-Soyuz Test Project. Marking the first ever international human spaceflight, the Test Project symbolized growing détente between the United States and Soviet Union; but it was also practical and self-interested. Involving a nine-day spaceflight during which an Apollo spacecraft carrying three American astronauts docked with a Russian Soyuz spacecraft with a crew of two, the mission allowed both parties to test the feasibility of international space rescue through compatible rendezvous and docking systems. Critically, the mission also demonstrated the viability of cooperation on more sensitive areas of technology which continued throughout the Cold War, namely through the exchange of scientific data related to ongoing space probes and robotic missions (Launius 2016). And it laid a foundation for the cooperative spirit that has been a hallmark of space exploration since the end of the Cold War.

In space, the end of the Cold War was marked by a 1992 agreement between the United States and Russia that led to astronaut exchanges and docking of NASA's

Space Shuttle with the Russian Mir space station. This process led to the creation of the International Space Station (ISS), an enduring symbol of space cooperation for the last two decades. Estimated to cost $150 billion to date, the ISS is the single largest, and most expensive space venture ever undertaken. Featuring a permanent human presence in outer space, it is made possible through collaboration among core partners, namely NASA in the United States, Roscosmos in Russia, the European Space Agency, the Japan Aerospace Exploration Agency (JAXA), and the Canadian Space Agency. In all, the ISS has received contributions from 15 states and hosted 236 astronauts from 18 different countries and counting (NASA 2019b).

From a space security perspective, such cooperation is critical to expanding access to outer space. Indeed, the significant expense and technical challenges associated with space exploration means that it is almost impossible without the pooling of financial resources and technical expertise, which in turn helps to expand both individual and collective capacity and participation in outer space. Cooperation on space cooperation marks a meeting of self-interest and shared achievement.

Space exploration reflects both the security of outer space and the international cooperation necessary to sustain it. It is also a means to this end. While the ups and downs of cooperative ventures are influenced by geopolitical and national security interests, over time such cooperation and shared interests in space has transcended these dynamics. Collaboration provides a critical mode of transparency and promotes a shared understanding of space activities. Mutual dependency in such a challenging environment builds trust in a field of activity that overlaps with strategic competition. Working and living together in outer space demands not only language training, but cultural understanding. Much like the iconic Earthrise image instills a sense of shared humanity, cooperation and co-existence in outer space introduces a shared vulnerability and mutual dependency.

Indeed, today the United States and Russia remain bound together on the ISS, mutually dependent on one another for access to and use of it. Since the retirement of the Space Shuttle, NASA has been dependent on Russia for access via Soyuz, while Russia depends on the United States for satellite communication. Although both parties strive to end such dependency, this entrenched cooperation has largely transcended geopolitical tensions on Earth, including political fallout related to recent interventions in Ukraine. Joint activities on the ISS have been largely exempt from rising hostilities and sanctions elsewhere.

Nonetheless, there are exceptions to the spirit of cooperative space exploration, most notably between the United States and China. China is not a member of the ISS and cooperation between the United States and China is extremely limited. This is largely a reflection of security concerns, which escalated following the Chinese anti-satellite (ASAT) demonstration that successfully destroyed one of its own ageing weather satellites in 2007. In 2011, the U.S. Congress adopted legislation barring any scientific activity between the United States and China involving either the National Aeronautics and Space Administration (NASA) or the White House Office of Science and Technology Policy (United States Congress 2012). However, American law does not ban private sector agreements with China, and in 2017 SpaceX carried the first experiment independently designed and fabricated in China to the

ISS. Further, a 2015 inaugural Civil Space Dialogue initiated tentative efforts to improve cooperation and transparency between the two states (U.S. Department of State 2015). This dialogue is tepid but ongoing, a testament to both the importance and challenges of cooperative relationships in a strategic environment.

More recently, cooperative efforts related to space exploration have been expanding beyond advanced spacefaring states to include emerging ones. Led by UN COPUOS, the 50th anniversary meeting of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50) took place in June 2018. First among seven thematic priorities was to expand global partnerships on space exploration and innovation, specifically to "promote cooperation between spacefaring states and emerging space states," so that exploration becomes "open and inclusive on a global scale" (UN Office of Outer Space Affairs (OOSA) 2017). Reinforcing this goal, China marked the occasion by inviting all members of UN COPUOS to participate in its upcoming Tiangong-3 space station and intends to train astronauts from developing countries. In this way, cooperation in space exploration is a means to bridge not only strategic divides in outer space, but also varying abilities to access outer space. Indeed, capacity-building to expand access to outer space is another core feature of space security cooperation.

Expanding Access to Space: Cooperation and Capacity-Building

The central tenet of space security is the ability for all to be able to access and use space for peaceful purposes. Today, in addition to the European Space Agency (ESA), eight countries have direct access to space through national space launch capabilities; more than 70 operate national satellites (Union of Concerned Scientists 2019). International cooperation has been essential to this growth in access to space.

Like space exploration, some initiatives are international. For example, the KiboCUBE joint project between UNOOSA and the Japan Aerospace Exploration Agency (JAXA) makes use of Japan's Kibo module on the ISS to launch CubeSats on behalf of educational and research institutions from developing countries. But most cooperation is bilateral. NASA currently has over 700 agreements with international organizations (NASA 2019a), China has 120 (Xinhua 2018). And the Indian Space Research Organisation (ISRO) cooperates with at least 50 states (ISRO 2017). The essential role of bilateral relationships in expanding national capabilities is evident using the example of the United Arab Emirates (UAE). Established in 2014, its national space agency signed more than 16 cooperative agreements with international space agencies within the first 3 years of operation. (Permanent Mission of the United Arab Emirates to the United Nations 2017). Cooperative endeavors include advanced capabilities such as space exploration and human spaceflight.

Regional cooperation is also a critical tool for increasing access to outer space and its benefits. It is most developed in Europe, where the European Space Agency (ESA) facilitates space activities among its 22 Member States. A similar approach is being adopted in Africa, where progress on an African space strategy and African Space Agency is spurring greater cooperation. Likewise, in 2019 the Arab Space Coordination Group was initiated by the UAE and ten other countries (Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Saudi Arabia, and Sudan); its first collective project will be an Earth observation satellite used to monitor the environment and climate.

And yet regional cooperation also illustrates the enduring tensions between cooperation and strategic competition. This is clear in Asia, where two competing organizations foster cooperation: the Asia-Pacific Regional Space Agency Forum (APRSAF) and the Asia-Pacific Space Cooperation Organization (APSCO). The APRSAF was established by Japan in 1993; it currently includes participation by public and private entities from 40 counties. Modest achievements include the Sentinel Asia collaborate initiative to apply remote-sensing capabilities to support disaster management in the region. APSCO, established by China in 2005, includes Bangladesh, China, Iran, Mongolia, Pakistan, Peru, Thailand, and Turkey. Its activities have focused on training and data-sharing, disaster monitoring, and an Asia-Pacific Ground-Based Space Object Observation System (APOSOS) for monitoring objects in Earth orbit.

Indeed, security tensions and competition mean that cooperative efforts are rarely straightforward. The example of India's GSAT-9 communications satellite is a case in point. Described as a "gift" for the South Asian Association for Regional Cooperation (SAARC), Pakistan nonetheless opted out of participation (Set 2017). Likewise, the BRICS (Brazil, Russia, India, China, and South Africa) economic association, with its goal of decreasing dependency on the West, also provides a vehicle for space cooperation, but struggles with internal competition. Nonetheless, it has agreed to a first substantive project, namely the creation of a "virtual" remote sensing satellite constellation through a data-sharing system.

It is also clear that cooperative efforts can reinforce rather than transcend strategic interests. Although still taking shape, China's ambitious Belt and Road development and infrastructure initiative may be a case in point. Intended to integrate China into a network of global trade, the Belt and Road includes a Spatial Information Corridor to bring participants into China's space-based infrastructure services, including the BeiDou satellite navigation system, satellite communications, meteorology, remote sensing, and space-based broadband Internet service (Hui 2018). Including 65 national participants as of 2018, it is described as a cooperative initiative aimed at capacity-building and common development across members.

Some have questioned the long-term aims of such deep integration (Robinson 2019). More concretely, however, it speaks to the presence of underlying strategic undertones that can influence space security cooperation and capacity building. Specifically, Pakistan's participation in 2018 was expanded to include access to the BeiDou's military service (Abi-Habib 2018). Indeed, the persistence and even growth of national security uses – and corresponding geopolitical tensions – in outer space can impede other areas of cooperation related to safety and sustainability, which are needed to mitigate the challenges associated with more extensive uses of outer space.

Cooperation for Safety and Sustainability

While indicative of space security, growing access to and use of space is not without challenges. In particular, the natural environment of outer space, while seemingly vast, is also fragile. As a global commons, it is open to everyone, and almost everything, from satellites to Tesla Roadsters, giant disco balls, and advertising. Most of what we put into space never returns, contaminating the environment for future use. To avoid a tragedy of the commons – and to enhance the safety of operations for everyone – cooperation is essential. And it is increasingly taking place. Indeed, it is noteworthy that the limited dialogue between the United States and China is focused largely on safety including "space and terrestrial weather; space debris and spaceflight safety; and the long-term sustainability of outer space activities" (U.S. Department of State 2016). But here too, there are limits, largely imposed by national security interests.

The mitigation of space debris is one of the most significant examples of cooperative efforts to enhance the security of outer space. The Inter-Agency Space Debris Coordination Committee (IADC) evolved from cooperation between NASA and ESA following the creation of a large debris cloud in low Earth orbit caused by an Ariane 1 second stage explosion in 1986. It now includes 13 of the leading civil space agencies from around the world, including Roscosmos and the China National Space Administration (CNSA). The Committee published the first set of international guidelines related to space debris mitigation, a version of which was adopted by the UN General Assembly in 2008 as "voluntary measures to which all space actors should comply" (UNOOSA 2010). While implementation is uneven, collective efforts to limit the production of new debris in orbit have significantly reduced the rate of debris accumulation and contributed to enhanced sustainability of the environment.

Cooperation on safety is another core contribution to space security, primarily through efforts to mitigate natural threats including Near Earth Objects (NEOs) and space weather. Depending on size, a NEO that enters Earth's orbit can damage or destroy populated areas such as cities, or even the planet itself. Cooperation is emerging to mitigate this risk. In 2013 members of UN COPUOS created two international networks to coordinate detection, early warning, and future planetary defense measures: the International Asteroid Warning Network (IAWN), and the Space Mission Planning Advisory Group (SMPAG). The goal of each network is to ensure that all countries – including those with limited space capabilities – are aware of the threats – and to enable global warning, mitigation, and response processes. Space weather is another focus of safety cooperation. Space weather refers to changes in the space environment and geomagnetic storms that stem from flares and electromagnetic radiation emitted from the sun, which threatens security of objects both in outer space and on Earth by causing radiofrequency blackouts, orbital drag on satellites, and powerful power surges. In 2017 the expert group first convened by UN COPUOS in 2014 laid out a roadmap for greater international cooperation and information exchange on space weather events aimed at developing global modelling and forecasting capabilities (UN COPUOS 2017). Separately, the

World Meteorological Organization is wrapping up a 4-year plan that includes similar aims.

Key to these efforts is the role of UN COPUOS in coordinating cooperation for improved safety and sustainability. One of its most significant achievements in this regard is the identification of, and agreement to, a set of 21 voluntary guidelines for the long-term sustainability of outer space activities. Adopted by the Scientific and Technical Subcommittee in 2018 and referred to the UN General Assembly in 2019 along with a comprehensive preamble, the guidelines are indicative of the intersection of space security and cooperation. As stated in the preamble, they are "premised on the understanding that outer space should remain an operationally stable and safe environment that is maintained for peaceful purposes and open for exploration, use and international cooperation by current and future generations, in the interest of all countries…." (UN COPUOS 2018). The aim of the guidelines is to assist both individual and collective mitigation of risks; moreover, the guidelines emphasize that international cooperation is *required* to implement and monitor their effectiveness and impact.

Adoption of these guidelines is significant. In addition to articulating the link between cooperation, safety, and sustainability, they lend further impetus to the efforts on which states are already pursuing cooperation, such as space weather and debris mitigation. However, there are clear omissions. Beyond noting that they should be compatible with the "defense or national security" interests of states, the guidelines exclude activities more closely related to these interests. This includes issues that involve dual-use capabilities such as active debris removal and advanced rendezvous and proximity operations, as well as issues that approach arms control, such as restraints on intentional interference or harm of satellites. Also absent is an effort to create a more global or inclusive approach to space situational awareness. This issue lends insight into the tension between the security of outer space as a global commons that requires cooperation, and national security interests that drive strategic competition.

Indeed, while debris mitigation has emerged as a focal point of international cooperation for the security of outer space, safety from debris – largely a function of space situational awareness (SSA) – reflects much more cartelized modes of cooperation. An extension of space surveillance, SSA refers to the ability to generate actionable knowledge from surveillance data in order to identify, track, and catalog objects in orbit. This focus on action means that it is a critical capability for both safety *and* security in outer space. And, because no single actor has an absolute capability to precisely monitor every object on orbit, SSA depends on cooperation. But despite its widespread utility, there is no global system for monitoring objects and activities in outer space. Neither is there a global system to manage space traffic and safety.

This does not mean that there is no cooperation; indeed, cooperation on SSA is extensive, but also selective, and largely military (Lal et al. 2018). The most prominent measures are supported by the United States. The U.S. Department of Defense, which has by far the most advanced capabilities through its Space Surveillance Network of global terrestrial and space-based telescopes. It shares significant information on a public-platform, free of charge, through the Spacetrack.org website as part of the SSA Sharing Program run by the Combined Space Operations Center under the U.S. Strategic Command (USSTRATCOM). The U.S. Department of Defense also supports general space traffic management by providing conjunction warnings to other operators.

However deeper cooperation to share classified data that supports more advanced safety and security needs on orbit is restricted to bilateral agreements between USSTRATCOM and key allies and security partners. As of early 2019, these included agreements with 19 states (the Netherlands, Brazil, the United Kingdom, the Republic of Korea, France, Canada, Italy, Japan, Israel, Spain, Germany, Australia, Belgium, the United Arab Emirates, Norway, Denmark, Thailand, and New Zealand), in addition to ESA and the European Organization for the Exploitation of Meteorological Satellites, and more than 77 commercial space companies (US Strategic Command Public Affairs 2019).

Other actors are in turn developing their own, independent SSA capabilities. This includes European states, who are pooling national capabilities under a Space Surveillance and Tracking Support Framework. Russia and China also maintain extensive national capabilities, but do not widely share data; China is working narrowly with APSCO partners to develop the Ground-Based Space Object Observation Network. Several private companies also have commercial SSA capabilities and services. Such duplication would be beneficial to space security if data were pooled or otherwise used for verification and corroboration, but it is not. Instead, the persistent lack of *global* collaboration and cooperation on SSA and corresponding efforts to manage traffic in space reflects the ongoing difficulty of balancing the security *of* space as a common interest and national security concerns linked to the growing use of outer space.

New Patterns of Cooperation: Space Security Versus National Security

The physical security of objects in outer space is a core element of space security, entwining the objectives of national security with common security interests. In addition to natural threats such as space weather or impacts from debris, physical harm to satellites can include intentional efforts to interfere with space systems. From a space security perspective, core challenges include not only how to protect individual systems from harm, but also how to maintain strategic stability and prevent escalation of conflict into the space environment. This is a key function and goal of early efforts to foster cooperative space exploration activities and remains a feature of the ISS. However, the ability to adopt cooperative approaches on strategic issues closely related to national security such as restrictions on the deployment of weapons or the use of force in outer space remains the most intractable challenge to the security of outer space.

To be sure, there are mutual interests in preventing the use of military force in outer space, including overwhelming dependency on space assets for national security as well as the indiscriminate and long-lasting harm that violent conflict could inflict on the space environment. These concerns coalesced following the 2007 ASAT demonstration by China, which both threatened assured access to critical space systems in low Earth orbit and created the largest ever debris cloud in space. The event also marked a turning point in strategic relations in outer space from self-restraint to a simmering arms race.

The OST includes some provisions to prevent the worst of foreseeable conflict in outer space, including a ban on the orbiting of weapons of mass destruction and all military installments on the Moon. Other restrictions on armed conflict in outer space are scant, and mostly bilateral. Evidence of nascent protections for strategically sensitive satellites can be glimpsed in the Anti-Ballistic Missile Treaty, the Strategic Arms Limitation Talks, the Intermediate-Range Nuclear Forces Treaty, the Threshold Test Ban treaty, the Peaceful Nuclear Explosions Treaty, the Strategic Arms Reduction Treaty, the Conventional Forces in Europe Treaty, and the second Strategic Arms Reduction Treaty, which all included measures barring interference with "national technical means of verification," widely understood to mean satellites used to monitor treaty compliance (Black 2008). Although narrowly applied and eventually abrogated, the Anti-Ballistic Missile Treaty involved a restriction against the placement of ballistic missile interceptors in outer space. To be sure, this era also coincided with rampant and sometimes outlandish development of anti-satellite weapons. But self-restraint avoided the operational deployment of such weapons. The general belief was that space is too important to risk becoming a domain of military conflict.

This tacit cooperation to maintain the strategic stability of the outer space environment has eroded. Beginning with the abrogation of the ABM treaty by the United States in 2002, and including renewed interest and demonstration of ASAT capabilities including by China in 2007, the United States in 2008, and India in 2019, as well as the revival of Soviet-era weapons systems by Russia, there is now a simmering arms race in outer space. Insecurity generated by these activities is exacerbated by new on-orbit capabilities such as advanced rendezvous and proximity operations. These capabilities can support a range of both legitimate and more nefarious activities in outer space, blurring safety and security issues.

Efforts to agree to additional arms control measures in the Conference on Disarmament have stalled for over 30 years. So have efforts to develop additional voluntary measures related to behavior in outer space – for example through a code of conduct. A cooperative approach to support additional transparency and confidence-building measures (TCBMs) has also eroded (West 2018). In place of a shared belief in the need to avoid armed conflict in outer space, and international cooperation to restrict it, a growing number of states including China, India, Russia, France, Japan, the United Kingdom, and the United States now see space as a likely domain of armed conflict in the near future. From a strategic perspective, this shift introduces significant vulnerabilities for national security because of dependency on space systems for almost all military and security operations. Ongoing military developments such as a new United States Space Force are symptomatic of this growing sense of insecurity.

Like SSA, this vulnerability is leading to new patterns of selective cooperation based on deepening military alliances and strategic partnerships. Most cooperation involves the sharing of space-based capabilities and data for terrestrial military purposes. Examples include the participation of Canada, the Netherlands, and the United Kingdom in the U.S. Advanced Extremely High Frequency (AEHF) satellite program, and the shared use of the U.S. Wideband Global Satcom communications service by Canada, Denmark, Luxembourg, the Netherlands, New Zealand, and Australia. But such cooperation is expanding to include more formal alliance structures based on defense interests in outer space. This includes cooperation within the Five Eyes intelligence alliance (Australia, Britain, Canada, New Zealand, and the United States) such as the sharing of signals intelligence. Five Eyes partners also participate in the annual U.S. Air Force Space Command Wargames (Schriever wargames) which in recent years has expanded to include France, Germany, and Japan. Expanded cooperation is the focus of the newly renamed Combined Space Operations Center, which provides command and control of space forces and features greater cooperation with U.S. allies and partners including the Five Eyes, Germany, and Japan. The NATO (North Atlantic Treaty Organization) alliance is also making moves to recognize space as a domain of warfare, and military cooperation.

The number of security partnerships in outer space is growing, particularly in Asia. The long-standing US–Japan alliance now firmly includes defense cooperation in space. The United States has also increased defense-related cooperation in space with India, now a major defense partner. Japan and India are also coordinating bilaterally; in 2018, the Japan–India Space Dialogue included a focus on security, namely sharing satellite data and surveillance technology (Hayashi 2018). India and France, which had long cooperated on civil space programs, have also extended cooperation to security applications (Rajagopalan 2018). Likewise, India and Vietnam have expanded their strategic relationship to include defense cooperation in space, primarily through satellite imagery (Parameswaram 2018). China's ongoing cooperative endeavors also have strategic undertones, particularly the Belt and Road Initiative, which includes military cooperation with Pakistan and could expand to include additional partners.

There are positive aspects to such cooperation. The pursuit of objectives such as inter-operability and shared capabilities builds capacity and is a key mode of resilience in outer space: the ability to withstand interference with a satellite's capabilities and maintain core functions. As a technical ability, resilience can enhance security to both deliberate and natural threats, bridging safety and security concerns in outer space. This has been a clear benefit of global cooperation related to satellite services for positioning, timing and navigation. Some argue that resilience could also deter aggression in space and stabilize the strategic environment (Air Force Space Command 2016). But the extension of strategic partnerships into space could also further escalate military tensions and even conflict in outer space, particularly in the absence of broader cooperative efforts to restrict the most damaging forms of conflict and protect strategic assets. This is particularly concerning in the face of rising geopolitical competition and acute vulnerability in outer space.

Further, it is also unclear how rising strategic competition and deep but narrow security cooperation in outer space will affect emerging areas of space activities such as lunar exploration and resource extraction.

New Issues: The Moon and Space Resources

China's historic robotic landing on the far side of the Moon in 2019 heralded a new focus of human activity in outer space defined by lunar exploration and the possible exploitation of space-based resources. Other missions – either underway or planned – include India's Chandrayaan 2 robotic mission to the lunar South Pole and NASA's new Artemis program to build a lunar Gateway in orbit around the Moon and return American astronauts to the lunar surface. China has long-term plans to send astronauts to the Moon and develop a research base there. The European Space Agency also has a robotic lunar program and interest in resource extraction, as does Japan. The collective focus is on the lunar south pole, where resources critical for human survival and sources of power – including water ice and helium-3 – are known to exist. Unlike in the past, the goal is not merely to touch the Moon, but to leave a permanent mark: to establish bases and even human settlements, and to extract resources. Non-state actors are also participating. In 2019 SpaceIL launched the first private robotic lander to the Moon. Commercial ventures such as Moon Express – which focus on extracting the Moon's resources – are also set to arrive. Several companies are setting up businesses to shuttle items between Earth and the Moon. Billionaires Elon Musk (SpaceX) and Jeff Bezos (Blue Origin) aim to establish private exploration programs and human colonies. Whether or not individual missions advance, the long-term trend is toward a more expansive and possible exploitive human presence in outer space. Implications for the cooperative security of outer space are unclear.

Although colonization and the search for resources are long-standing themes of human history, they introduce new questions in relation to the security of outer space. These include issues related to contamination and the environmental integrity of the Moon; processes for – and the implications of – claiming locations for research and settlement; the mingling of scientific, commercial, and military interests; and how to extend the benefits of lunar access and extractive resources in space to the global community. Critically, these new activities reinforce established tensions between cooperation and strategic competition that drive dynamics related to sustainability, security, and equity in the global commons of outer space.

Thus far, signs of cooperation are strong. The return to the Moon is a global pursuit. The 2018 Global Exploration Roadmap published by the International Space Exploration Coordination Group describes "an emerging international consensus to proceed with lunar exploration using a cislunar platform as the initial step in space exploration beyond low Earth orbit" (International Space Exploration Coordination Group 2018). The Group of 15 space agencies, including NASA, Roscosmos, and CNSA, participate in this nonbinding initiative, discussing common interests and identifying potential areas of cooperation. It has also adopted new terms of reference as a basis to foster international space cooperation and dialogue. Other cooperative initiatives include the nonprofit Moon Village Association, which is working to foster an international collaborative approach to lunar exploration and For All Moonkind, which seeks to protect and preserve human heritage including individual landing sites on the Moon.

There is also considerable bilateral cooperation emerging. Significantly, NASA received Congressional approval to collaborate with China on lunar landing research and transmitted images of the lunar landing site for the Chang'e 4 mission in 2019 (David 2019). China has invited additional international partnerships for its planned Chang'e 6 lunar sample return mission. The United States is engaging both international and private sector partners for the Artemis human exploration program. India and Japan are pursuing joint projects; China has also reached out to India.

Some efforts to cooperate on the governance of resource-use are taking shape. The Hague International Space Resources Governance Working Group is formulating governance recommendations and guidelines; the *Draft Building Blocks for the Development of an International Framework on Space Resource Activities* was published in 2017 (Universiteit Leiden 2017). There are discussions within UN COPUOS to potentially create a working group to further explore legal considerations. Bilaterally, Luxembourg – one of the greatest proponents of private sector resource extraction in outer space – is cooperating with like-minded countries including the UAE and Japan.

These are all good signs, but there are few agreed upon rules to put inspiration into practice. Efforts to operationalize peaceful uses and cooperative approaches of the OST in the 1979 Moon Agreement failed. And despite a global focus, the sense of a new race to the Moon and underlying strategic interests – including a possible scramble for resources – cannot be ignored. Beyond a focus on national security in outer space, the United States aims for pre-eminence in the space domain (The White House 2018), while China seeks to be a "space power in all respects" (The State Council Information Office of the People's Republic of China 2016). Private and commercial interests introduce yet another competitive component. How these tensions will interact with lunar exploration – and resource ambitions – is not clear. Neither is it clear that the spirit of cooperation that informs the principles of peaceful and equitable use of outer space in the OST will endure. As U.S. Vice President Pence has asserted, those who get there first – and stay – will write the "rules and values of space" (The White House 2019). The future of cooperation in outer space may depend on who gets there first.

Conclusion: The Future of Space Security Cooperation

Outer space is a fragile environment, a critical resource, and a focus of strategic competition. Maintaining the ability of this domain to support safe, sustainable, and secure access and use for all – the essence of space security – requires cooperation. Further, cooperation is embedded as a core value within the institutions and laws that govern outer space, a *raison d'être* of both the UN Committee on the Peaceful uses of Outer Space, and the Outer Space Treaty. Over time, cooperative efforts to improve the safety and sustainability of space operations, and to expand global access to outer space, have widened, increasing both individual and collective capacity and well-being in a challenging environment.

But while cooperation is the norm in outer space, it is not straightforward. National security interests present the most persistent impediment. At times cooperation has provided a way to transcend relationships by developing trust and transparency. The ISS is a key example. Other times, cooperation trails strategic and geopolitical interests, marked most strongly by the ongoing absence of international cooperation to limit the use of force in outer space. Combined with intense dependency on vulnerable space-based systems for military and national security objectives, this void is giving way to new, narrow patterns of cooperation among national security allies and partners. While such cooperation can enhance security *in* space for those involved, it may come at cost to the long-term security *of* space by increasing strategic rivalry and facilitating the escalation of conflict into outer space.

New uses and users of outer space are also changing the dynamics of space security cooperation. Examining the revival of lunar and human exploration alongside interest in the exploitation of space-based resources indicates a shift toward a more intense, long-term, and strategic human activities in presence that will leave a fundamental mark on worlds beyond our planet. This shift is being undertaken with considerable international cooperation. And yet underlying strategic rivalry as well as commercial and private interests may well impede efforts to implement the values of the Outer Space Treaty, including peaceful uses, cooperation, and global benefit. A cooperative approach to the security of outer space remains a prudent way to ensure that these values are upheld.

References

Abi-Habib M (2018) China's 'Belt and Road' plan in Pakistan takes a military turn. New York Times, 19 December. https://www.nytimes.com/2018/12/19/world/asia/pakistan-china-belt-road-military.html. Accessed 11 Sept 2019

Air Force Space Command (2016) Resiliency and disaggregated space architectures. White paper. https://www.afspc.af.mil/Portals/3/documents/AFD-130821-034.pdf?ver=2016-04-14-154819-347. Accessed 11 Sept 2019

Black S (2008) No harmful interference with space objects: the key to confidence-building. In: Security in space: the next generation, United Nations Institute for Disarmament Research, 31 Mar–1 Apr

David L (2019) Farside politics: The West eyes Moon cooperation with China. Scientific American, 7 February. https://www.scientificamerican.com/article/farside-politics-the-west-eyes-moon-cooperation-with-china/. Accessed 11 Sept 2019

Hayashi S (2018) Japan-India 'Space-Dialogue' to include surveillance sharing. Nikki Asian Review, 9 December 2018. https://asia.nikkei.com/Politics/International-relations/Japan-India-Space-Dialogue-to-include-surveillance-sharing. Accessed 11 Sept 2019

Hui J (2018) The spatial information corridor contributes to UNISPACE+50. China National Space Administration technical presentation to the scientific and technical subcommittee of the UN Committee on the Peaceful Uses of Outer Space http://www.unoosa.org/documents/pdf/copuos/stsc/2018/tech-08E.pdf. Accessed 11 Sept 2019

Indian Space Research Organization (ISRO) (2017) International cooperation. https://www.isro.gov.in/international-cooperation. Accessed 9 Sept 2019

International Space Exploration Coordination Group (2018) Government representatives from 45 countries and international organisations meet at the 2nd International Space Exploration Forum (ISEF2), 26 April. https://www.globalspaceexploration.org/wordpress/?p=792. Accessed 11 Sept 2019

Kay WD (1998) John F. Kennedy and the two faces of the U.S. space program, 1961–63. Pres Stud Q 28(3):573–586

Kennedy JFK (1961) Inaugural address. Special message to Congress on Urgent National Needs, 25 May 1961, Washington, DC. John F. Kennedy Library and Museum website: https://www.jfklibrary.org/asset-viewer/archives/JFKWHA/1961/JFKWHA-032/JFKWHA-032

Lal B et al (2018) Global trends in space situational awareness (SSA) and space traffic management (STM). Science and Technology Policy Institute, 10 October. https://csis-prod.s3.amazonaws.com/s3fs-public/event/181010_SSA_CSIS.PDF. Accessed 11 Sept 2019

Launius R (2016) Key developments in USA/USSR space cooperation during the Cold War. https://launiusr.wordpress.com/2016/08/15/some-key-developments-in-usaussr-space-cooperation-during-the-cold-war/. Accessed 9 Sept 2019

NASA (2019a) Active international agreements by signature date (as of 30 June 2019). https://www.nasa.gov/sites/default/files/atoms/files/house_approps_action_international_saas_active_as_of_6-30-2019.pdf. Accessed 9 Sept 2019

NASA (2019b) International cooperation. https://www.nasa.gov/mission_pages/station/cooperation/index.html. Accessed 9 Sept 2019

Parameswaram P (2018) India-Vietnam defense relations in the spotlight with bilateral visit. The Diplomat, 18 June. https://thediplomat.com/2018/06/india-vietnam-defense-relations-in-the-spotlight-with-bilateral-visit/. Accessed 11 Sept 2019

Permanent Mission of the United Arab Emirates to the United Nations (2017) UAE statement to the fourth committee on international cooperation in the peaceful uses of outer space. 17 October. https://www.un.int/uae/statements_speeches/uae-statement-fourth-committee-%E2%80%9Cinternational-cooperation-peaceful-uses-outer. Accessed 9 Sept 2019

Rajagopalan RP (2018) From sea to space: India and France deepen security cooperation. The Diplomat, 15 March. https://thediplomat.com/2018/03/from-sea-to-space-india-and-france-deepen-security-cooperation/. Accessed 11 Sept 2019

Robinson J (2019) State actor strategies in attracting space sector partnerships: Chinese and Russian economic and financial footprints. Prague Security Studies Institute. http://www.pssi.cz/download/docs/686_executive-summary.pdf. Accessed 11 Sept 2019

Sagdeev R, Eisenhower S (2008) United States-Soviet space cooperation during the Cold War. NASA. https://www.nasa.gov/50th/50th_magazine/coldWarCoOp.html. Accessed 9 Sept 2019

Set S (2017) India's regional diplomacy reaches outer space. Carnegie India https://carnegieendowment.org/files/7-3-2017_Set_IndiaRegionalDiplomacy_Web.pdf. Accessed 11 Sept 2019

The State Council Information Office of the People's Republic of China (2016) China's space activities in 2016. White Paper 27 December. http://www.scio.gov.cn/wz/Document/1537091/1537091.htm. Accessed 11 Sept 2019

The White House (2018) President Donald J. Trump is unveiling an America first national space strategy. 23 March. https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unveiling-america-first-national-space-strategy/. Accessed 11 Sept 2019

The White House (2019) Remarks by Vice President Pence at the fifth meeting of the National Space Council, Huntsville Alabama, 26 March. https://www.whitehouse.gov/briefings-statements/remarks-vice-president-pence-fifth-meeting-national-space-council-huntsville-al/. Accessed 11 Sept 2019

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (Outer Space Treaty) (1967). https://2009-2017.state.gov/t/isn/5181.htm. Accessed 11 Sept 2019

UN COPUOS (2017) Report of the scientific and technical subcommittee on its fifty-fourth session, held in Vienna from 30 January to 10 February 2017. http://www.unoosa.org/oosa/oosadoc/data/documents/2017/aac.105/aac.1051138_0.html. Accessed 11 Sept 2019

UN COPUOS (2018) Guidelines for the long-term sustainability of outer space activities. Conference room paper by the Chair of the working group on the long-term sustainability of space activities (June). http://www.unoosa.org/res/oosadoc/data/documents/2018/aac_1052018crp/aac_1052018crp_20_0_html/AC105_2018_CRP20E.pdf. Accessed 11 Sept 2019

Union of Concerned Scientists (2019) Satellite database. https://www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database. Accessed 9 Sept 2019

United States Congress (2012) H.R.2112 – consolidated and further continuing appropriations act. Sec. 539. https://www.congress.gov/bill/112th-congress/house-bill/2112/text. Accessed 9 Sept 2019

United States Department of State (2015) The first meeting of the U.S.-China space dialogue. Media note. www.state.gov/r/pa/prs/ps/2015/09/247394.htm. Accessed 9 Sept 2019

United States Department of State (2016) The second meeting of the U.S.-China space dialogue. Media note, October 24. https://2009-2017.state.gov/r/pa/prs/ps/2016/10/263499.htm. Accessed 11 Sept 2019

Universiteit Leiden (2017) Draft building blocks for the development of an international framework on space resource activities, September. https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht%2D%2Den-ruimterecht/space-resources/draft-building-blocks.pdf. Accessed 11 Sept 2019

UNOOSA (2010) Space debris mitigation guidelines of the committee on the peaceful uses of outer space. United Nations. http://www.unoosa.org/pdf/publications/st_space_49E.pdf. Accessed 11 Sept 2019

UNOOSA (2017) UNISPACE +50 thematic priorities, p 3. http://www.unoosa.org/documents/pdf/unispace/plus50/thematic_priorities_booklet.pdf. Accessed 9 Sept 2019

US Strategic Command Public Affairs (2019) USSTRATCOM, Polish space agency sign agreement to share space services, data. USSTRATCOM, 11 April. https://www.stratcom.mil/Media/News/News-Article-View/Article/1811729/usstratcom-polish-space-agency-sign-agreement-to-share-space-services-data/. Accessed 11 Sept 2019

West J (2018) Why the chances of conflict in outer space are going up. Ploughshares Monit 39(4), winter. https://ploughshares.ca/pl_publications/why-the-chances-of-conflict-in-outer-space-are-going-up/. Accessed 11 Sept 2019

West J (ed) (2019) Space security 2019. Project Ploughshares, Waterloo

Xinhua (2018) China strengthens international space cooperation. China Daily, 19 April. http://www.chinadaily.com.cn/a/201804/19/WS5ad899eea3105cdcf65195a1.html. Accessed 9 Sept 2019