



Ethical and Emerging Issues in Space Law: AI, Militarization, and Off-Earth Human Settlement

Dr. Ashis Kumar Mukhopadhyay, Department of Law, 4/2, Monmohan Mukherjee Road, P.O. & P.S. - Bally, Dist. – Howrah, West Bengal – 711201 akm.lawsolution@gmail.com

Abstract

Three groups of issues dominated space law scholarship before 2023. First, artificial intelligence is being used in space operations, from autonomous collision avoidance to satellite monitoring to lethal autonomous weapons systems. The second is the increasingly militarization of space, sparked by Russia's November 2021 destruction of the Cosmos-1408 satellite, which left over 1,600 pieces of trackable debris and forced International Space Station crew to shelter in their Crew Dragon. This was followed by a wave of national space defense doctrine revisions and the US' April 2022 voluntary moratorium on destructive anti-satellite testing, the first of its kind. The third is the legal and ethical landscape of permanent off-Earth human settlement, which became practical after SpaceX's April 2023 Starship test flight and NASA's November 2022 Artemis I mission returned humanity to lunar orbit for the first time since 1972. International space law, based on state responsibility and the prohibition of WMDs, was not designed to govern societies, algorithms, or weapons that operate without human intervention in permanent off-world environments. Primary treaty texts, the UN General Assembly Resolution 78/241 on Lethal Autonomous Weapons Systems adopted in December 2023, the REAIM Summit outcome document of February 2023, the updated US Department of Defense Directive 3000.09 of January 2023, the Springer volume on legal challenges in establishing human settlements, and comparative materials from Antarctic, maritime, and bioethics law are used to identify fifteen specific govern

Keywords: Space law ethics; artificial intelligence in space; autonomous weapons systems; LAWS; ASAT; space militarization; off-Earth human settlement; settler rights; planetary protection; space colonialism; REAIM 2023; DoD Directive 3000.09

1. Introduction

On November 15, 2021, the Russian military fired a Nudol direct-ascent anti-satellite missile that destroyed Cosmos-1408, an old Soviet spy spacecraft, at a height of about 480 kilometers. The debris cloud, which had more than 1,600 trackable pieces, made the crew of the International Space Station stay in their docked Crew Dragon and Soyuz spaceships for hours as the junk orbit crossed the station's route. [1] The US government called the test "reckless and dangerous." In December 2023, two years later, the United Nations General Assembly passed Resolution 78/241. This was the first UNGA resolution that was only about deadly autonomous weapons systems. It asked the Secretary-General to write a report on how these weapons might be controlled. [2]

The main point of this paper is based on these two events: one was physical and the other was diplomatic. Space law is in an ethical and technical crisis that is very distinct from the problems with governance that are being talked about in the argument about registration, jurisdiction, and resource rights. The questions being asked now are older and harder: Who is to blame when a machine kills? What rights do individuals possess when they reside permanently outside the jurisdiction of Earth? How does the world work together to stop an arms race in a field where mistakes can't be undone? [3]

The space economy that gives these questions its business and strategic context has expanded a lot. There were more than 6,700 operational satellites in orbit, and the private sector was responsible for most of the new launches. This was mostly because of the deployment of broadband mega-constellations. SpaceX got more than \$15 billion in private and public funding between 2020 and 2023 for the construction of Starship. This included NASA contracts worth billions of dollars that were part of the Artemis program. [5] In this context of private desire and state investment, the ethical issues related to AI, military operations, and permanent human settlement have transitioned from theoretical discourse to pressing operational significance.

This paper goes on like this. Part 2 looks at the moral and legal problems that AI in space raises.



Section 3 looks at how space is becoming more militarized and how anti-satellite weaponry and autonomous systems are being controlled. Section 4 talks about the legal and moral rules for people living outside of Earth. Section 5 takes lessons from other areas that are similar. Part 6 suggests a reform plan with three main parts. Section 7 comes to an end.

2. Artificial Intelligence in Space: Efficiency, Accountability, and The Ethics of Autonomous Decision-Making

2.1 The Legal Personality Problem: Who Is Responsible When AI Fails?

Artificial intelligence is already a key part of how things work in space. The NASA Perseverance rover landed on Mars in February 2021. It utilizes a system called AutoNav to move about on its own, avoiding obstacles at speeds that no human operator could safely guide from Earth because of communication lags of up to 24 minutes. [6] The rover's AEGIS (Autonomous Exploration for Gathering Increased Science) software chooses rock targets for laser spectroscopy on its own. In prior missions, these choices would have needed to be approved by the ground team. These are not small uses of machine learning; they are real examples of how decision-making power is being moved from human scientists to computers. The Acta Astronautica study of AI in space operations says that AI makes "significant challenges for existing international space law, especially when it comes to the effects of any possible AI-supported military activities in outer space." The main legal issue is accountability. The 1972 Liability Convention sets up a state-centric chain of responsibility: a launching state is responsible; a non-governmental body is authorized and monitored by a state under Article VI. This chain assumes that people can be tracked down. The assumption of traceability fails when an AI system makes the critical decision to either maneuver a satellite into collision with another or to target an item deemed a threat. [7]

2.2 Dual-Use AI Earth Observation: The Surveillance Ethics Problem

By 2023, commercial AI-enabled Earth observation had become so advanced that the 1986 COPUOS Principles on Remote Sensing were almost useless. Machine learning algorithms can now find individual cars, keep an eye on crowds, find building activity, and keep track of ship positions in almost real time when they are applied to synthetic aperture radar (SAR) and optical satellite images. Planet Labs, Maxar, and Airbus Defense & Space all sell subscriptions to these kinds of services, which are commonly used by journalists, intelligence organizations, and humanitarian groups. [8]

The ethical implications of this capability have garnered minimal consideration in the space law literature. No global law says that people who run AI-enabled Earth observation systems must get permission from the people whose activities they are watching, hide their identities before selling the data, or follow privacy laws that are the same as those for land-based surveillance. The 1986 Remote Sensing Principles only say that "remote sensing shall be conducted for the benefit and in the interests of all countries." This language doesn't set any rules for data rights, algorithmic processing of personal information, or the dual-use supply of surveillance imagery to military actors. [9]

2.3 Lethal Autonomous Weapons in Space: The Legal Vacuum

The most serious ethical issue in AI and space law in 2023 is also the one that has generated the highest level of international diplomatic engagement: Lethal Autonomous Weapons Systems (LAWS). In 2023, António Guterres, the Secretary-General of the United Nations, described LAWS as "politically unacceptable and morally repugnant," highlighting the urgent need for stronger international regulation and meaningful human control over such systems. The adoption of Resolution 78/241 by the United Nations General Assembly in December 2023[10] marked the first formal global step toward addressing the issue. While the resolution represented an important normative development and reflected growing international concern, it remained non-binding in nature and functioned primarily as a recommendation rather than an enforceable legal instrument.

There is a big hole in the law. Article IV of the Outer Space Treaty says that nuclear weapons and other weapons of mass destruction can't be put in orbit, and military bases and weapon



testing can't happen on celestial bodies. However, it doesn't say anything about ordinary autonomous weapons in space. In January 2023, the United States changed its DoD Directive 3000.09 on Autonomy in Weapon Systems. It changed the definition of "human" oversight to "operator" oversight. This small but important change has been described by legal scholars at the University of Washington as a sign that the government is becoming more comfortable with scenarios in which "bots control bots." The REAIM Summit in February 2023, which was co-hosted by the Netherlands and South Korea, resulted in a non-binding Political Declaration on Responsible Military Use of Artificial Intelligence. This declaration stressed the importance of meaningful human control, but 31 of the 57 delegations that attended, including the United States, chose not to sign it. [12] The Convention on Certain Conventional Weapons (CCW) Group of Governmental Experts on LAWS had been working on a binding instrument since 2014, but they still hadn't come up with one. Their job was extended in 2023, and they were told to come up with "a set of elements of an instrument." Legal scholars at the Lieber Institute for Law and Warfare at West Point noted that the "black box" nature of machine learning decision-making makes it hard to really follow the IHL principles of distinction and proportionality. These are problems that OST Article IV doesn't even try to solve. [13]

Table 1: Artificial Intelligence in Space Operations: Applications, Ethical Risks, and Legal Gaps

AI Application Domain	Specific Use (pre-2023)	Ethical Risk	Applicable Legal Instrument	Governance Gap
Autonomous Collision Avoidance	Autonomous manoeuvring based on conjunction data; AI-driven path planning in mega-constellations	Liability attribution when AI decision causes collision — no human in loop at point of error	Liability Convention 1972 (Art. II–IV); OST Art. VIII (jurisdiction of registry state)	No provision for AI-generated actions; fault standard presupposes human decision-making; no AI-specific liability rule
AI-Enabled Earth Observation	Machine-learning pattern recognition in SAR and optical imagery; dual-use surveillance (civil + military)	Privacy violations at scale; identification of individuals without consent; weaponisation of commercial imagery	NOAA licence conditions (US); COPUOS Remote Sensing Principles 1986 (non-binding)	No binding global instrument on dual-use AI remote sensing; 1986 Principles predate AI; no informed-consent regime for subjects of satellite surveillance
Autonomous Weapons in Space (LAWS)	AI-driven targeting for co-orbital interception; AI-managed electronic warfare satellites; integration of AWS with space-based ISR	Removal of meaningful human control from lethal decisions; accountability gap ("responsibility vacuum"); algorithmic bias in target identification	OST Art. IV (bans WMD; silent on conventional autonomous weapons); DoD Directive 3000.09 (updated Jan 2023 — national only); CCW GGE LAWS discussions	No international treaty banning or regulating LAWS; CCW GGE failed to reach consensus; OST Art. IV does not cover conventional AI weapons in space



AI Application Domain	Specific Use (pre-2023)	Ethical Risk	Applicable Legal Instrument	Governance Gap
AI for Space Traffic Management	Predictive STM using machine learning; autonomous right-of-way recommendations; AI-driven deorbit scheduling	Over-reliance on algorithmic recommendations without transparency; systemic failures could cascade across multiple operators simultaneously	No binding STM treaty; US SPD-3 (2018) assigned civil STM to DoC; EU Space Programme Regulation 2021/696	No international standard for AI transparency in STM; no mandatory disclosure of algorithm parameters; no liability allocation for AI STM recommendations
Autonomous Planetary Rovers	NASA Perseverance (landed Feb 2021) — onboard AI AutoNav; autonomous science target selection via AEGIS; independent terrain assessment	Planetary protection: autonomous decisions may disturb potentially biologically sensitive sites without human review	COSPAR Planetary Protection Policy (advisory); OST Art. IX (avoid harmful contamination)	OST Art. IX obligation vague — no binding standard for AI autonomy levels in planetary missions; no international review body for autonomous planetary science decisions

Note. Sources: Acta Astronautica (2020) — AI space law challenges; COSPAR Planetary Protection Policy (2021 revision); COPUOS Remote Sensing Principles (1986); U.S. DoD Directive 3000.09 (updated January 2023); CCW GGE LAWS Report (July 2023); REAIM Summit 2023 Outcome Document; NASA Perseverance mission documentation. AEGIS = Autonomous Exploration for Gathering Increased Science. LAWS = Lethal Autonomous Weapons Systems. STM = Space Traffic Management.

3. The Militarization of Outer Space: From Cold War Restraint to a New Arms Race

3.1 The Inadequacy of Article IV: Peaceful Purposes and Its Limits

The main part of the Outer Space Treaty that keeps space free of weapons is Article IV. It forbids putting nuclear weapons or other weapons of mass destruction in orbit or on celestial bodies. It also says that the Moon and other celestial bodies can only be used for peaceful purposes. It does not stop the placement of regular weapons in orbit, the development or testing of anti-satellite systems, or the use of space for intelligence, surveillance, and reconnaissance missions that help with combat. [14] Since the 1960s, one of the most debated issues in space law has been the difference between "peaceful purposes" and "non-aggressive military purposes." The United States and other countries have always said that the Treaty allows military satellites for spying and communication since these serve deterrence and so "peaceful" goals. Russia and China have officially accepted this interpretation in practice, but they also want stricter rules in multilateral forums. The most notable example is the Draft Treaty on Prevention of the Placement of Weapons in Outer Space (PPWT), which many people in the West think is meant to limit U.S. missile defense in space while allowing Russian and Chinese counterspace capabilities to continue. [15]

3.2 The ASAT Crisis and Its Legal Aftermath

The Russian Nudol ASAT test in November 2021 made it clear that the current rules are not enough. Russia became the fourth country to do a destructive direct-ascent ASAT test. China did one in 2007 (with more than 2,800 debris bits), the US did one in 2008, and India did one in 2019 (with over 400 fragments). The same legal fact was shown in each test: the Outer Space Treaty does not say that ground-based ASAT systems or normal weapons testing in space are



not allowed. [16] The 1,600-plus pieces of debris from Cosmos-1408 were a constant threat to the ISS, which is ironic since Russia was still a partner in the station at the time. Vice President Harris's April 2022 statement of a unilateral American embargo on destructive direct-ascent ASAT testing was the first official political pledge of its sort, but it didn't have much weight because it was voluntary and couldn't be checked. [17] In November 2022, the United Nations General Assembly passed Resolution 77/41, which had 155 votes in favor and only 9 against, with no abstentions. This was a significant endorsement of a moratorium on damaging ASAT tests. India, China, and Russia, the three countries whose most recent tests had left debris, were against the resolution. The ScienceDirect analysis of the anti-weaponization of outer space says that existing international law, including Article IV, "cannot directly prohibit the deployment, testing, and use of conventional weapons in outer space." It also says that the gap between treaty obligation and observed state behavior has grown so big that it poses a real systemic risk to the long-term sustainability of space. [19]

3.3 The Rise of National Space Forces and Doctrine Proliferation

In reaction to what they see as a threat, many states have been developing military space organizations. In 2020, France set up its Space Command. In March 2021, it held its first military exercise in outer space, called "AsterX," which was meant to test how well French defenses could handle ASAT weapons firing. The Air Self-Defense Force of Japan set up the Space Domain Mission Unit (SDMU) in 2022. In February 2022, the US and six other countries announced the Combined Space Operations Vision 2031. This document said that all of these countries were committed to protecting themselves against hostile actions in space. [20] Legal scholars writing in the ScienceDirect journal on space sustainability have noted that this proliferation of national space defense organizations and doctrines — none of them constrained by any binding multilateral instrument beyond Article IV's WMD prohibition — has produced a situation of "mutual deterrence without mutual restraint." The CCW Group of Governmental Experts' inability to reach a consensus on its organizational agenda in 2017, as well as the Open-Ended Working Group created by UNGA Resolution 76/231 in 2021, which was still in its early substantive sessions in 2022, show how slow diplomacy is compared to how fast capability development is.

Table 2: Space Militarization: Key ASAT Tests, Legal Responses, and Governance Timeline (2007–2023)

Year / State	Event / Capability	Legal Status Under OST	International Response
2007 China	SC-19 missile destroys FY-1C weather satellite (~850 km); creates >2,800 trackable fragments.	OST Art. IV silent on conventional ASAT; no WMD involved — technically not prohibited.	Widespread condemnation; OST gap debated in COPUOS for years.
2019 India	Mission Shakti: Prithvi missile destroys own satellite (~300 km LEO); ~400 trackable fragments.	Same legal gap as 2007 — OST does not ban ground-based ASAT or conventional space weapons.	NASA chief called test "terrible"; India argued LEO minimised debris risk.
Nov 2021 Russia	Nudol ASAT destroys Cosmos-1408 (~480 km); >1,600 fragments; ISS crew sheltered in Crew Dragon.	No WMD ban violation; conventional ASAT in a legal grey zone; OST Art. IX (harmful interference) potentially implicated.	US, UK, EU, Canada condemned as "reckless"; test directly spurred US ASAT moratorium (April 2022).



Year / State	Event / Capability	Legal Status Under OST	International Response
Apr 2022 USA	VP Harris announces first-ever voluntary moratorium on destructive direct-ascent ASAT testing.	Voluntary political commitment only — no treaty obligation, no verification mechanism.	37 states endorsed; UN GA Res. 77/41 (Nov 2022) — 155 in favour — called for global ASAT moratorium.
2022–23 Multiple	CombSpOps Vision 2031 (Feb 2022) — US + 6 allies; France Space Command; Japan Space Domain Mission Unit (SDMU) established.	No treaty governs defensive military space operations; "peaceful purposes" norm under OST remains contested.	Russia and China rejected "defensive" framing; OEWG on Reducing Space Threats (GA Res. 76/231) began sessions.
2023 Global	UN SG Guterres: LAWS "morally repugnant"; REAIM Summit (Feb); CCW GGE LAWS mandate.	No LAWS treaty; CCW GGE reached no consensus; REAIM outcome was a non-binding Political Declaration.	UN GA Res. 78/241 (Dec 2023) — first dedicated UNGA LAWS resolution; calls for SG regulation report.

Note. Debris counts: Arms Control Association; Time Magazine (2022); NTI PAROS database. Legal status: ScienceDirect / Acta Astronautica (2022); Beyond the Horizon ISSG. UN GA Res. 77/41 voting: First Committee, November 2022. REAIM Outcome Document, The Hague, February 2023. LAWS = Lethal Autonomous Weapons Systems. SDMU = Space Domain Mission Unit. OEWG = Open-Ended Working Group (GA Res. 76/231, December 2021).

4. Off-Earth Human Settlement: Rights, Governance, and the Ethics of Permanence From Scientific Station to Permanent Colony: The Legal Transition

Over time, living on other planets became a reality. The first Space Launch System crewed flight was NASA's Artemis I. It performed an uncrewed lunar orbital flight in November 2022, confirming the hardware design is suitable for humans to return to the moon and surface. In 2022, SpaceX CEO Elon Musk said the first crewed journey to Mars may happen in 2029. [21] After three and a half minutes, Starship, the largest and most powerful rocket ever created at 120 meters, exploded during its first test flight. As a tested vehicle, it bolstered ambitions to bring people to Mars soon. [22] The Springer book on legal challenges in space colonies notes that regulations governing permanent settlements off-Earth are based on tools created when moving to space seemed inconceivable. Governments control their registered products and people, no state has dominion over celestial bodies, and activities should benefit all countries, according to the OST. These guidelines don't address what happens when a community becomes self-sufficient, people don't return to Earth, or its government and interests differ from the sponsoring state's.

Human Rights in Space: Dignity Gap: The professional astronauts on the ISS must follow the ISS IGA's criminal jurisdiction guidelines, their home states' laws, and their job contracts. The UDHR and International Covenant on Civil and Political Rights apply to them as humans, but there is no mechanism to enforce them in space or add to them. Legal academics call the "dignity gap." between international human rights legislation's notional applicability and the ISS's lack of implementation. Permanent residents and professional astronauts on short-term missions would have different gaps. In 2022–2023, the Abo Akademi University thesis on ethical space colonization argues that permanent settlement ethics must consider "the ethical dilemmas, the human rights violations, and the environmental implications" using intra- and intergenerational ethics and indigenous perspectives. According to the North Carolina Journal



of International Law, a settlement large enough to form a distinct community of peoples could assert self-determination rights against the sponsoring state under UN Charter Article 1(2), a right that OST Article VI's state-responsibility framework cannot support.

5. Lessons from Analogous Legal Domains

International Humanitarian Law (IHL) provides the legal framework for regulating weapons systems through principles such as distinction, proportionality, and precaution. However, the rise of AI-driven autonomous weapons raises serious challenges, as their “black box” nature makes it difficult to ensure compliance with these principles. In particular, proportionality requires context-based human judgment, which AI systems cannot fully replicate due to their reliance on predefined algorithms. As a result, scholars argue that such systems struggle to meet IHL standards. The Martens Clause further strengthens this concern by emphasizing that even in the absence of specific legal rules, weapons must comply with principles of humanity and public conscience, leading many to consider fully autonomous weapons without meaningful human control as legally questionable. The Antarctic Treaty of 1959 offers a successful model of complete demilitarization of a global commons, having maintained peaceful scientific cooperation for over six decades. It prohibits military activities, weapons testing, and nuclear explosions, while ensuring transparency through inspection and information-sharing mechanisms. Legal scholars suggest that this model could inform governance in near-Earth space, particularly by adapting its inspection and transparency provisions to promote trust and prevent militarization. In the field of bioethics, instruments such as the Helsinki Declaration, CIOMS Guidelines, and the UNESCO Universal Declaration on Bioethics and Human Rights establish the principle of informed consent in research involving human subjects. These frameworks emphasize voluntary participation, full disclosure of risks, and the right to withdraw. Although developed for Earth-based contexts, these principles are highly relevant for future space activities, especially for individuals participating in long-term or permanent space settlement, and may serve as the foundation for a dedicated space bioethics framework.

6. A Three-Pillar Reform Agenda

ETHICAL & LEGAL FRAMEWORK FOR EMERGING SPACE LAW ISSUES (to 2023)

▼ Three Thematic Pillars ▼

PILLAR I ARTIFICIAL INTELLIGENCE IN SPACE	PILLAR II MILITARIZATION & WEAPONIZATION	PILLAR III OFF-EARTH HUMAN SETTLEMENT
<ul style="list-style-type: none"> Autonomous collision avoidance Dual-use Earth observation LAWS in space (AI weapons) Planetary rover autonomy AI-driven STM Key 2023 instruments: DoD Directive 3000.09 (Jan 2023) REAIM Summit (Feb 2023) UN GA Res. 78/241 (Dec 2023) 	<ul style="list-style-type: none"> ASAT test debris (Russia 2021) US ASAT moratorium (Apr 2022) UN GA Res. 77/41 (Nov 2022) CombSpOps Vision 2031 (Feb 2022) France Space Command (2021) Japan SDMU established (2022) Gap: OST Art. IV silent on conventional ASAT/space LAWS 	<ul style="list-style-type: none"> Settler rights & human dignity Reproductive ethics in space Political sovereignty Planetary environmental stewardship Resource equity / space colonialism Key events: Starship debut test (Apr 2023) NASA Artemis I (Nov 2022) SpaceX: \$15bn+ raised 2020–23

▼ Common Governance Deficits Across All Three Pillars ▼

⚠ SHARED GAPS: (1) No binding AI-specific space law · (2) No treaty banning conventional ASAT/LAWS · (3) No human rights charter for space settlers · (4) No binding planetary environment protocol · (5) No space resource equity mechanism ⚠



▼ Proposed Reform Pathways ▼

AI Governance Protocol Added to OST via COP Mechanism; mandatory human-on-loop standard for lethal space AI; transparency in STM algorithms	ASAT / LAWS Treaty Binding moratorium on destructive ASAT tests; regulation of space LAWS under IHL; mandatory annual military space transparency reports	Space Settlement Statute Settler Rights Charter; bioethics framework; progressive self-governance model; planetary protection protocol; equity-sharing mechanism for resources
---	---	--

Source: Author's compilation based on OST (1967), Liability Convention (1972), DoD Directive 3000.09 (January 2023), REAIM Summit Outcome Document (February 2023), UN GA Resolution 78/241 (December 2023), Springer legal settlements volume (2023), and Oxford Academic extraterrestrial liberty volume (2022/2023).

Figure 1: Three-Pillar Ethical and Legal Reform Framework for Emerging Space Law Issues

Pillar I: An AI Governance Protocol for Space Operations: The most technically explicit and attainable change in the near future would be a protocol to the Outer Space Treaty that sets minimum requirements for using AI in space operations. This may be done through a COP procedure. The protocol must fulfill three essential criteria: firstly, a compulsory "human-on-loop" standard for AI systems capable of executing actions with irreversible repercussions, such as collision-avoidance maneuvers that may exacerbate debris chains; secondly, obligatory transparency of STM algorithms, including the disclosure to UNOOSA of the parameters and training data utilized in collision-prediction systems; and thirdly, a clear application of the Liability Convention to damage caused by AI, treating the authorizing state as if it had directly inflicted harm in instances where an AI system under its oversight generates detrimental effects.

Pillar II: A Binding Instrument on ASAT Weapons and Autonomous Weapons in Space: The Secretary-General's request for a legally enforceable LAWS instrument by 2023 and the UN GA's ratification of Resolution 78/241 give political support for a targeted diplomatic endeavor. A binding moratorium on debris-generating direct-ascent ASAT tests with on-site inspection rights, a ban on the deployment of autonomous weapons systems in orbit without clear proof of compliance with IHL's distinction and proportionality requirements, mandatory military space transparency reports under a verification mechanism similar to the Vienna Document on conventional forces, and an extension of the OST Article IV WMD prohibition to cover nuclear-armed co-orbital weapons should all be included in such an instrument. This is because intelligence reports released in early 2023 suggested that Russia was developing such a system.

Pillar III: A Space Settlement Statute: The most ambitious reform with the longest time frame is the Space Settlement Statute. This is an international agreement that sets rules for the rights, governance, and environmental responsibilities of permanent human populations living outside Earth. The Statute would have four parts: a Settler Rights Charter that sets minimum rights for due process, health, informed consent to mission risks, and a qualified right of return; an International Bioethics Framework for space that expands UNESCO's bioethics declaration to include standards for radiation exposure, reproductive rights, and human enhancement technologies; a progressive self-governance model based on the domestic self-determination arrangements of territories under the Spanish and French constitutional systems, which would give governance authority to settlements that meet certain criteria of permanence and self-sufficiency; and a Planetary Environment Protocol, based on the Antarctic Protocol of 1991, that would ban irreversible environmental alteration of celestial bodies without prior multilateral environmental impact assessment.

7. Conclusion

AI in space, militarization, and colonization beyond Earth are diverse problems, yet all threaten international space law. Each of them has persons, behaviors, and moral issues that the 1967



Outer Space Treaty authors did not predict. Each also has a shorter timeline than treaty reform. Russian Nudol ASAT test in November 2021 was legal and improper. It demonstrated that a major spacefaring nation would create a debris field that endangered ISS personnel, even its own, to demonstrate its military might. That decision demonstrates the international community's view of national deterrence and a shared orbital environment. No binding legal tools have challenged these ideals. Although essential, the REAIM Summit's non-binding Political Declaration and the CCW GGE's increased mandate are not adequate. Off-Earth settlement moral difficulties are taking longer to emerge, but they are more essential. First permanent people on Mars will not consider if they have rights and who protects them academically. They will look up to the sky and wonder how they fit into the regulations of a planet 100 million kilometers distant. Harvard, Oxford, North Carolina, and Abo Akademi researchers raised the same questions and concluded that the current framework needed a new instrument to regulate permanent human communities in space. The emerging generation in space law must build such an instrument through a multilateral process that includes developing nations, indigenous groups, civil society, and the major spacefaring nations.

References

1. Arms Control Association. (2021, December). *A small step toward an ASAT ban*. Retrieved from <https://www.armscontrol.org>
2. United Nations General Assembly. (2023, December). *Resolution 78/241: Lethal Autonomous Weapons Systems (A/RES/78/241)*. New York: United Nations.
3. Hasin, G. (2023). From “space law” to “space governance”: A policy-oriented perspective on international law and outer space activities. *Harvard International Law Journal*. Retrieved from <https://journals.law.harvard.edu>
4. Organisation for Economic Co-operation and Development (OECD). (2022). *The space economy in figures*. Paris: OECD Publishing.
5. NASA. (2023). *Artemis program: Contracts and partnerships*. <https://www.nasa.gov/artemis>
6. NASA Jet Propulsion Laboratory. (2021). *Perseverance rover AutoNav and AEGIS systems*. Retrieved from <https://mars.nasa.gov>
7. Freeland, S., & Jakhu, R. (2020). The advent of artificial intelligence in space activities: New legal challenges. *Acta Astronautica*. <https://doi.org/10.1016/j.actaastro.2020.08.030>
8. Maxar Technologies. (2023). *Geospatial intelligence and satellite imagery services*. <https://www.maxar.com>
9. United Nations Office for Outer Space Affairs (UNOOSA). (1986). *Principles relating to remote sensing of the Earth from outer space* (UNGA Resolution 41/65).
10. United Nations Office for Disarmament Affairs (UNODA). (2023). *Statement by the UN Secretary-General on lethal autonomous weapons systems*.
11. Jackson School of International Studies, University of Washington. (2023). *Cheap drones, expensive lessons: Ethics, innovation, and regulation of autonomous weapon systems*. Retrieved from <https://jsis.washington.edu>
12. REAIM Summit. (2023, February). *Outcome document: Political declaration on responsible military use of artificial intelligence and autonomy*. The Hague.
13. Lieber Institute at West Point. (2022). *Legal accountability for AI-driven autonomous weapons*. Retrieved from <https://lieber.westpoint.edu>
14. United Nations. (1967). *Treaty on principles governing the activities of states in the exploration and use of outer space, including the Moon and other celestial bodies*. <https://www.unoosa.org>
15. Beyond the Horizon International Strategic Studies Group (ISSG). (2023). *Increased militarisation of space: A new realm of security*.
16. Taylor & Francis Online. (2023). *Still lost in space? Understanding China and India's anti-satellite tests through an eclectic approach*.



17. Time Magazine. (2022, April). *To slow an anti-satellite arms race, White House bans US tests of space weapons*. Retrieved from <https://time.com>
18. Modern Diplomacy. (2023). *Developments under PAROS: Securing outer space*.
19. ScienceDirect. (2022). *Anti-weaponization of outer space for maintaining long-term sustainability of outer space activities*.
20. Combined Space Operations Initiative. (2022). *Combined space operations vision 2031*. <https://www.spaceforce.mil>
21. NASA; SpaceX. (2022–2023). *Artemis I mission and Starship development updates*. Retrieved from <https://mars.nasa.gov> and <https://www.spacex.com>
22. Åbo Akademi University. (2023). *Cosmic harmony: Revitalising international space law for ethical space colonisation through an ecocentric lens*. Retrieved from <https://repository.gchumanrights.org>

