

**International Space Law through the lenses of Environmental
Law principles to promote Earth-space system governance**

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INTERNATIONAL SPACE LAW THROUGH THE LENSES OF ENVIRONMENTAL LAW PRINCIPLES TO PROMOTE EARTH-SPACE SYSTEM GOVERNANCE

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Abstract: This article examines how international environmental law principles may contribute to the governance of the Earth-space system through their integration with international space law. It argues that outer space should be considered part of the broader environmental framework and analyses the compatibility between environmental law principles and the Outer Space Treaty regime. The paper examines principles including no harm, prevention, precaution, cooperation, intergenerational equity, polluter pays, environmental impact assessment and common but differentiated responsibilities. It further evaluates how these principles may strengthen existing space law obligations and fill current legal gaps concerning environmental protection and sustainability of outer space activities. The article concludes that integrating environmental principles into international space law may support a more coherent and sustainable Earth-space governance framework.

Keywords: International Environmental Law; International Space Law; Earth-space Governance; Sustainability; Outer Space Activities.

Resumo: Este artigo examina a forma como os princípios do direito internacional do ambiente podem contribuir para a governação do sistema Terra-espaço através da sua integração com o direito internacional do espaço. O estudo sustenta que o espaço exterior deve ser considerado parte integrante do quadro ambiental global e analisa a compatibilidade entre os princípios do direito do ambiente e o regime do Tratado do Espaço Exterior. O artigo analisa princípios como o princípio da não produção de danos, prevenção, precaução, cooperação, equidade intergeracional, poluidor-pagador, avaliação de impacto ambiental e responsabilidades comuns mas diferenciadas. O artigo conclui que a integração destes princípios no direito

do espaço pode contribuir para uma governação mais coerente e sustentável do sistema Terra-espaço.

Palavras-chave: Direito Internacional do Ambiente; Direito Internacional do Espaço; Governação Terra-espaço; Sustentabilidade; Atividades Espaciais.

1. Introduction

Space activities are rapidly increasing in terms of the number of launches, satellites, payloads sent into outer space and investment in the sector. This growth is driven by the diversification of launching actors, the expansion of satellite internet and internet of things constellations, and the emergence of debris removal and in-orbit servicing activities (European Space Agency, 2024; Novaspaces, 2024).

Until recently, the protection of the Earth's environment and the sustainability of outer space activities were largely treated as separate issues. Discussions regarding environmental governance primarily focused on terrestrial environmental protection, while debates on the sustainability of outer space activities concentrated on the preservation of the outer space environment itself. However, space activities inevitably affect both Earth and outer space environments through their upstream and downstream segments.

Recent scientific studies increasingly suggest that the growing number of launches and atmospheric re-entries may significantly affect the atmosphere, marine environment and biodiversity (American Astronomical Society, 2024; Williams et al., 2024). Consequently, proposals advocating Earth-space governance and cosmo legal approaches (Cirkovic, 2021; Cirkovic, 2022) increasingly seek to integrate Earth system governance and space governance into a coherent Earth-Space System Governance framework (Cirkovic, Wood, 2025; Lawrence et al., 2022; Vidaurre, Gilbert, 2023; Williams et al., 2024; Yap, Kim, 2023).

This article contributes to the discussion through interpretation of fundamental outer space law principles in the eyes of environmental law principles, rather than advocating the creation of a new legal instrument. Consequently, the article aims to explore how existing principles and instruments of international law may contribute to the legal governance of the Earth-space system.

2. Interaction between International Space Law and International Environmental Law

The proposal for the legal governance of the Earth-space system is based on the integration of international space law and international environmental law, since outer space may also be considered part of the environment (Ünüvar, 2026; Vidaurri, Gilbert, 2023). Such integration may contribute to clarifying international obligations concerning the protection of both the Earth and outer space environments, thereby strengthening the implementation of the existing legal framework governing outer space activities and fostering Earth-space system governance.

The integration of international space law and international environmental law is not merely a theoretical exercise. It is also legally plausible from the perspectives of international environmental law, international space law and treaty interpretation.

From the perspective of international environmental law, reference may first be made to the Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration, 1972) and the Rio Declaration on Environment and Development (Rio Declaration, 1992). Principle 2 of the Stockholm Declaration provides that *"the natural resources of the earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations"* (Stockholm Declaration, 1972).

Furthermore, article 44(2) of the Constitution of the International Telecommunication Union (ITU Constitution, 1992) defines radio frequencies and associated orbits, including the geostationary orbit, as limited natural resources. In this respect, it may be argued that Earth orbits may also fall within the broader scope of environmental protection obligations.

Similarly, Principle 2 of the Rio Declaration establishes that States have "the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction" (Rio Declaration, 1992). Areas beyond national jurisdiction generally include the high seas, the international seabed area, international airspace, Antarctica and outer space (InforMEA). Consequently, environmental protection obligations relating to areas beyond national jurisdiction may also extend to outer space.

From the perspective of international space law, article III of the 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) provides that States Parties shall conduct activities in outer space "in accordance with international law". This provision allows the consideration of other branches of international law relevant to outer space activities. Since international environmental law forms part of international law, environmental law principles may therefore also apply within the framework of international space law (Ribbelink, 2009).

Reference should also be made to treaty interpretation, particularly the principle of systemic integration that suggest that the treaties do not exist in isolation but must be interpreted within the broader framework of international law (Gardiner, 2015; Rosentreter, 2015; Merkouris, 2015).

The primary rule of treaty interpretation is contained in article 31(1) of the Vienna Convention on the Law of Treaties (VCLT, 1969) according to which treaties shall be interpreted in good faith in accordance with the ordinary meaning of their terms, in their context and in light of their object and purpose. Furthermore, article 31(3)(c) VCLT (VCLT, 1969) requires interpreters to take into account "any relevant rules of international law applicable in the relations between the parties".

The wording of article 31(3)(c) VCLT is particularly important because it refers specifically to "rules of international law", thereby encompassing treaties, customary international law and general principles of law (McLachlan, 2005). Moreover, the provision contains no temporal limitation, meaning that relevant rules may include norms existing either at the time of the treaty's conclusion or at the time a dispute arises (McLachlan, 2005; Villiger, 2009).

This approach has also been reflected in international jurisprudence. In *Amoco International Finance Corporation v Iran* (Amoco International Finance Corporation v Iran, 1987), the Iran-United States Claims Tribunal accepted that customary international law could fill lacunae in treaty provisions. Similarly, in *Esphahanian v Bank Tejarat* (Esphahanian v Bank Tejarat, 1983), the Tribunal relied on broader principles of diplomatic protection. In both the *MOX Plant* case (MOX Plant Case, 2001), and the *OSPAR Arbitration* (OSPAR Arbitration, 2003), tribunals accepted that

contemporary international law and practice could assist in interpreting treaty obligations pursuant to article 31(3)(c) VCLT (VCLT, 1969).

Accordingly, the integration of international space law, namely interpretation of international space law through the lenses of international environmental law constitutes a legally viable approach for strengthening Earth-space system governance under the existing framework of international law.

3. Environmental Principles and International Space Law

3.1. Environmental Principles to be Explored

International environmental law principles have become a prominent feature of its protection regime, mentioned in several UN documents and declarations, and have been a fundamental part of international decisions, therefore gaining customary international law status (Dupuy, Viñuales, 2018; Dupuy, Moli, Viñuales, 2021; Orlando, 2021).

Principles that have shaped the protection of the environment regime may also contribute to the governance of outer space activities, as examined by Viikari with regards to sustainable development, *sic utere*, the precautionary principle, common but differentiated responsibilities, the polluter pays principle, and outer space environmental protection (Viikari, 2008); by Cinelli, Pogorzelska with regards to the precautionary principle and space debris mitigation nexus (Cinelli, Pogorzelska, 2013); by Bhat with regards to the polluter pays principle, precautionary principle, intergenerational equity, notification and consultation, the principle of cooperation, common but differentiated responsibility, environmental reinstatement, sustainable use, and the protection of outer space nexus (Bhat, 2014); by Svárovská with regards to common but differentiated responsibilities and space debris removal nexus (Svárovská, 2021); by Cirkovic, Wood with regards to the precautionary principle, environmental impact assessment, and Earth-space systems protection nexus (Cirkovic, Wood, 2025); by Hopej, Malinowska with regards to the prevention principle, the precautionary principle, and the protection of outer space nexus (Hopej, Malinowska, 2023); by Hobe with regards to the no harm and space debris nexus (Hobe, 2012); and by Kaley-Isley, Blagojevic and Johnson with regards to no harm, the principle of

prevention and precaution, and the light pollution nexus (Kaley-Isley, Blagojevic, Johnson, 2026).

Drawing on the discourse surrounding environmental and space law, this work introduces the principles of no harm, prevention, precaution, cooperation, intergenerational equity, the polluter pays principle, environmental impact assessment and common but differentiated responsibilities briefly, as it is not my aim to discuss these principles themselves, but rather their integration into international space law.

- **The no harm principle** requires States to ensure that activities within their jurisdiction do not cause environmental harm to other States or to areas beyond national jurisdiction (Duvic-Paoli, 2018; Brunnée, 2021). Based on *sic utere* principle from Roman law (Percival, 2021), the principle was recognized in the *Trail Smelter Arbitration* (Trail Smelter Arbitration, 1941) and subsequently confirmed by the International Court of Justice (ICJ) in cases such as *Corfu Channel* (Corfu Channel Case, 1949, p. 22) and the ICJ's Advisory Opinion on the *Legality of Nuclear Weapons* (ICJ, *Legality of Nuclear Weapons*, 1996: para. 29). It is also reflected in Principle 21 of the Stockholm Declaration and Principle 2 of the Rio Declaration. The principle entails also a standard of due diligence to conduct environmental impact assessment as stated in the ICJ *Certain Activities Case* (ICJ, *Certain Activities/Construction of a Road*, 2015: para. 104).
- The prevention principle obliges States to adopt proactive measures before environmental harm occurs, regardless of whether their activities are conducted in accordance with international law, in the face of the existence of tangible risks, and is defined as a positive duty (Duvic-Paoli, 2018; De Sadeleer, 2021). It aims to prevent the occurrence of environmental harm rather than compensating it (Fitzmaurice, Wong, Crampin, 2022). This principle derives from Principle 21 of the Stockholm Declaration and Principle 2 of the Rio Declaration, while providing greater protection not only against damage to other States but also to areas beyond national jurisdiction (De Sadeleer, 2021). As reflected also in International Law Commission's 2001 Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities (ILC Draft Articles on Transboundary Harm, 2001), the harm must be significant. The

principle is also affirmed by the ICJ as being in the corpus of international law in ICJ's Advisory Opinion on the Legality of Nuclear Weapons (ICJ, Legality of Nuclear Weapons, 1996: para. 29).

- De The precautionary principle provides that the absence of full scientific certainty should not postpone measures preventing environmental degradation (Peel, 2021; De Sadeleer, 2021). It also entails regulating or even prohibiting activities that have the potential to pose an environmental threat, even though there is no conclusive or certain scientific evidence on the harm that the activity may cause (Sands, Peel, 2018; Peel, 2021). It was first mentioned in the 1985 Vienna Convention on the Protection of the Ozone Layer (Vienna Convention for the Protection of the Ozone Layer, 1985), and later reflected in Principle 15 of the Rio Declaration, and Art. 3 of the United Nations Framework Convention on Climate Change (UNFCCC, 1992). Even though its normative status and content is highly debated, Pulp Mills Case (ICJ, Pulp Mills, 2010: para. 164), International Tribunal for Law of the Sea (ITLOS) Advisory Opinion on Climate Change (ITLOS, Climate Change Advisory Opinion, 2024: para. 405) and recent ICJ Advisory Opinion on Climate Change (ICJ, Advisory Opinion on Climate Change, 2025: para. 290) affirmed the obligation of States to take measures taking into consideration the best available science.
- **The cooperation principle** is fundamental for the transboundary context, also having a link with notification, consultation and environmental impact assessment (Orlando, 2021). In the context of environmental protection, it gives duties to States with regards to governing the global commons and transboundary matters. In the context of global commons, States have an obligation of conduct in a way that is expected from a State acting in good faith (Dupuy, Viñuales, 2018). This was reflected in Principle 18 and 19 of the Rio Declaration, and confirmed in ICJ's *Certain Activities Case* (ICJ, *Certain Activities*, 2015: para. 104).
- **The polluter pays principle** obligates actors responsible for environmental damage to bear the associated costs. It is important to internationalise the cost of possible environmental harm as an externality in project planning and budget allocating. It is also

considered as a leverage to prevent environmental harm (De Sadeleer, 2020; Fitzmaurice, Wong, Crampin, 2022).

- **Environmental impact assessments** constitute a preventive environmental governance tool (Fitzmaurice, Wong, Crampin, 2022), and represent more as a procedural environmental principle included in Rio Declaration (Principle 17). That procedural obligation is also confirmed by the ICJ's *Pulp Mills Case* (ICJ, *Pulp Mills*, 2010: para. 206) and *Certain Activities Case* (ICJ, *Certain Activities*, 2015: para. 104). It has become customary international law as part of prevention and precaution principle and no-harm principle (Dupuy, Viñuales, 2018; Fitzmaurice, Wong, Crampin, 2022).
- **Intergenerational equity**: The principle of intergenerational equity requires the current generation to preserve environmental resources for future generations, and seen as part of sustainable development (Fitzmaurice, Wong, Crampin, 2022). But at the same time it allows the present generation to gain the benefits from the resources (Scholtz, 2021). It is mostly seen as a moral principle that is guiding the implementation of other norms rather than being a legal principle itself (Redgwell, 2016), although it is mentioned in Principle 1 of the 1972 Stockholm Declaration (Stockholm Declaration, 1972), Art. 4 of the 1972 World Heritage Convention (World Heritage Convention, 1972) and in Art. 3 of the UNFCCC (UNFCCC, 1992).
- **The principle of common but differentiated responsibilities** recognizes that States share environmental obligations while differing in capabilities and historical contributions. It got recognized by Principle 7 of the Rio Declaration, a more concrete version of principle of equity in the context of environmental protection (Cullet, 2021). And also become one of the important principles in Art. 4 of the UNFCCC (UNFCCC, 1992). It is also affirmed by international jurisprudence with regards to the obligations of States regarding climate change as in the ITLOS *Climate Change Advisory Opinion* (ITLOS, *Climate Change Advisory Opinion*, 2024: para. 241) and ICJ's *Advisory Opinion on Climate Change* (ICJ, *Advisory Opinion on Climate Change*, 2025: para. 290).

3.2. Principles of International Space Law to be Interpreted through the Lenses of Environmental Law Principles

Although international space law does not establish a separate and comprehensive regime dedicated specifically to the protection of the space environment, several principles contained in the existing framework contribute to both the protection of the Earth's environment from extraterrestrial contamination and the preservation of the outer space environment itself. These principles are reflected particularly in article IX of the Outer Space Treaty, including the principles of cooperation and mutual assistance, due regard, and avoidance of harmful contamination that are examined here (Bhat, 2014; Cinelli, Pogorzelska, 2013; Popova, Schaus, 2018; Viikari, 2008).

The principle of cooperation and mutual assistance contained in article IX of the Outer Space Treaty constitutes one of the guiding principles governing the exploration and use of outer space. The principle is closely linked to the freedom of exploration and use recognised under article I OST and promotes participation in space activities through international cooperation mechanisms (Tronchetti, 2013). It therefore facilitates access to outer space activities for States lacking independent technological or financial capabilities.

The principle of due regard is not defined in the Treaty. However, some commentaries or interpretation suggestions suggest that States should act with an appropriate standard of care, attention and observance toward the rights and interests of other States (Marchisio, 2009) or could be used to determine what is not responsible behaviour (Harrington, 2023) or a safeguard to ensure the use of outer space for benefit of all States (Jarose, 2023).

The avoidance of harmful contamination further provides that studies and activities in outer space shall be conducted in a manner that avoids harmful contamination of outer space, the Moon and other celestial bodies, while also preventing adverse changes in the Earth's environment resulting from the introduction of extraterrestrial matter. This provision establishes one of the principal environmental protection obligations contained in the Outer Space Treaty framework.

Moreover, the Convention on International Liability for Damage Caused by Space Objects (Liability Convention, 1972) and the Convention on

Registration of Objects Launched into Outer Space (Registration Convention, 1975) should be mentioned here. Liability Convention establishes a fault-based or absolute liability regime based on where the damage occurs (on Earth or in outer space), but the scope of the damage is confined to loss of life, personal injury, impairment of health, and damage to property (Dennerley, 2018; Schmalenbach, 2023). In that case, how environmental principles would be used to cover environmental damage caused by space objects is worth examining. As for Registration Convention, national and international space objects registers are important tools for informing international community on the general function of the object and its orbital parameters, and could be improved to inform more on providing environmentally related information (Jakhu, Jasani, 2018).

In addition to treaty provisions, several soft-law instruments further contribute to environmental protection in outer space. One important example is the Principles Relevant to the Use of Nuclear Power Sources in Outer Space adopted by the United Nations General Assembly (UN General Assembly, 1992). These principles provide guidance concerning the use of radioactive materials in outer space activities. Principle 3(1)(a) establishes that States should endeavour to protect individuals, populations and the biosphere against radiological hazards and should avoid significant contamination of outer space.

Reference should also be made to the Guidelines for the Long-term Sustainability of Outer Space Activities adopted by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS LTS Guidelines, 2019). According to these Guidelines, the long-term sustainability of outer space activities refers to the ability to maintain space activities indefinitely in a manner that ensures equitable access to the benefits of outer space exploration and use for present generations while preserving the outer space environment for future generations.

3.3. What further can be taken from the principles of environmental law?

As discussed above, this article proposes the integration of international space law and international environmental law principles, particularly through the interpretation of existing outer space law principles in light of the environmental law principles examined in the previous sections. In

general, under the polluter pays principle, those responsible for environmental harm should bear the costs associated with mitigating or remedying that harm. In the context of space, this principle could apply to entities responsible for generating space debris, which poses risks to satellites, space stations, and future missions. Moreover, cooperative efforts between states are essential for data-sharing, standard-setting, and coordinating space traffic management. The precautionary principle, and EIAs, would allow States to take measures against space operations from ground segment to space segment, understand their real environmental impact, and incentivise the development of technology to eliminate the harmful impact of outer space activities (e.g. environmentally friendly propellants, or space object components).

In this study, I suggest that the interpretation of outer space principles through lenses of environmental law principles may clarify, inform and guide the meaning of the Outer Space Treaty as highlighted in the ITLOS *Advisory Opinion on Climate Change* (ITLOS, Climate Change Advisory Opinion, 2024: para. 130) and in the ICJ's *Advisory Opinion on Climate Change* (ICJ, Advisory Opinion on Climate Change, 2025: para. 178) in order to strengthen the existing international environmental protection regime applicable to outer space activities, rather than giving it to the discretion of States. In other respects, these principles may contribute to filling current lacunae in international space law concerning environmental protection, sustainability and responsibility for harmful impacts arising from space activities through interpretation.

For this reason, the analysis below is divided into two separate tables. The first table examines how international environmental law principles may reinforce and further develop existing principles contained in international space law. The second table identifies environmental law principles that may contribute to filling existing legal gaps within the current framework of international space law.

Table 1. Suggested interpretation of existing principles

Current Principles in Space Law	Equivalent Principle or Tool in Environmental Law	Interpretation and Further Implementation
Principle of mutual assistance and cooperation in article IX of the OST	The principle of cooperation	By embracing the cooperation principle, States can work together to establish uniform guidelines for outer space activities, notifying procedures in the event of hazardous activities fostering a collective responsibility for preserving both Earth and outer space environment.
Due regard principle in article IX of the OST	The principle of prevention and precautionary principle, environmental impact assessment (EIA)	In the context of Earth and outer space, the prevention principle would mean implementing stringent protocols to avoid irreversible harm to Earth and outer space environment. Such protocols could include debris mitigation measures, responsible satellite end-of-life procedures, and careful planning of new space missions to minimize environmental risks. The precautionary principle would be especially relevant to outer space, where activities can have unknown and potentially significant adverse environmental impacts. Given the emerging nature of space technology and the lack of

		comprehensive data on its long-term effects e.g. atmospheric entries, a precautionary approach would require spacefaring entities to adopt stringent safeguards before launching potentially risky activities. Applying EIAs to outer space activities as an international obligation would entail a formalised process of reviewing and approving space missions based on their potential environmental impacts. As it is only provided by the national space laws, and mostly limited to the impact assessment related to the Earth environment, this would require wider implementation of identifying and mitigating risks associated with activities such as launch operations, satellite operation and deployment, space tourism, the use of nuclear materials in space, and even space mining on Earth and outer space. EIAs could become a critical tool for decision-makers to weigh the environmental trade-offs of space activities.
The avoidance of harmful contamination, nuclear power principles	No harm principle	When extended to Earth and outer space, the no harm principle would require that spacefaring nations prevent

		activities that could harm both the Earth and outer space environment, such as the creation of space debris that endangers satellites or pollutes orbital paths, as well as polluting the Earth environment through atmospheric re-entries. It aligns with article IX of the OST, which urges States to conduct space activities with due regard to avoid harmful contamination.
International and national space object register	No harm principle Prevention principle	Space object registry could be enhanced to include more environmentally related information such as propellant type, planned re-entry (not just date but also method), end-of-life disposal plan.
The definition of the long-term sustainability (LTS) of outer space	Intergenerational equity	When applied to Earth and outer space, this principle would support long-term sustainability policies that prevent the over-exploitation of space resources and protect orbital environments from debris accumulation. Intergenerational equity could drive a long-term perspective in Earth-space governance, prioritising sustainable use of outer space resources and preserving the space

		environment for future generations.
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Table 2. Suggested principles that could fill the gaps in international space law

The Polluter Pays Principle and International Liability in Outer Space	The Principle of Common but Differentiated Responsibilities (CBDR) and International Responsibility in Outer Space
Even though there is an international liability regime set forth by the Outer Space Treaty and the Convention on International Liability for Damage Caused by Space Objects (Liability Convention, 1972) in space law, it only covers certain damages such as loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural and juridical, or property of international organisations (Article I of the Liability Convention, 1972). Therefore, the implementation of the polluter pays principle in the context of outer space could apply to environmental damages caused by space objects on Earth and outer space. Moreover, due to the principle, States and entities would be responsible for generating space debris, which poses risks to satellites, space stations, and future missions. By holding polluters accountable, this principle would incentivise more responsible behaviour among space actors with respect to the protection of Earth and space environment.	In the context of space activities, States are internationally responsible for the national and non-governmental space activities to ensure the activities are conducted in accordance with article VI of the Outer Space Treaty, and furthermore they are responsible for the authorisation and continuous supervision of non-governmental entities' space activities. This provision of the Outer Space Treaty gives a generic responsibility to States that are involved or aim to be involved in outer space activities; however, it fails to impose responsibility and obligation on those that have been using outer space and benefiting from it without taking effective precautions to keep the outer space environment sustainable. In the outer space context, this principle could foster a more equitable approach to space governance, particularly for emerging spacefaring nations. For example, more established space powers might be expected to contribute more resources towards space sustainability efforts, while newer spacefaring nations may receive

	technical support to conduct environmentally sound space activities.
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4. Conclusion

The integration of international environmental law principles into the regulation of outer space activities may provide a more coherent and comprehensive framework for addressing the evolving challenges of space governance. Principles such as prevention, precaution, cooperation, intergenerational equity and polluter pays collectively support a holistic approach to sustainability and may contribute to the interpretation and further development of existing international space law obligations concerning the protection of both the Earth and outer space environments.

Moreover, the integration of these principles may help address current lacunae within international space law by strengthening mechanisms of environmental protection, responsibility, accountability and international cooperation. In this respect, environmental law principles may serve not only as interpretative tools but also as normative guidance for the future development of space governance.

The analysis developed in this study should be understood, for the most part, as a proposal for the interpretative and progressive development of international space law rather than as a description of obligations that already bind States as a matter of settled positive law. What can be considered established is the legal plausibility of the integration itself: outer space falls within the broader scope of areas of environmental concern beyond national jurisdiction, the Outer Space Treaty's reference to "international law" in article III permits the application of environmental law principles, and the systemic integration approach under article 31(3)(c) VCLT supplies a recognised interpretative pathway for doing so. What remains aspirational, and is offered here as an agenda rather than a conclusion, is the institutional translation of these principles into operative standards, for example, through the UNCOPUOS long-term sustainability guidelines, through national licensing regimes that already require environmental review, or through a future protocol clarifying the scope of "damage" under the Liability Convention.

By incorporating these principles into the governance of outer space activities, the international community may advance a model of Earth-space system governance that aligns the exploration and use of outer space with broader sustainability objectives and the interests of present and future generations.

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