

Space Debris: Principles of Environmental Law as Cornerstones Paving the Way for Regulation

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Introduction

§1 In Alfonso Cuarón's 2013 movie *Gravity*, things go wrong on a NASA mission when a Russian missile strike on a defunct satellite inadvertently causes a chain reaction of explosions and multiplication of space debris travelling at extremely high velocity. Very quickly, the NASA Space Shuttle is hit by debris and suffers irreparable damage, leaving Dr. Ryan Stone and Mission Commander Matt Kowalski as the last survivors of the mission, stranded in space without communication with Mission Control.

§2 This science fiction thriller may not be as speculative and fictional as one would like it to be. Decades of human activities in space have led to an ever-increasing amount of space debris gravitating in orbit. In February 2020, the European Space Agency published an estimation of the number of space debris in orbit: according to their findings, there are more than 128 million objects from one millimetre to one centimetre, 900 000 objects from one centimetre to ten centimetres, and 34 000 objects measuring more than ten centimetres¹. The exponential growth of the debris population poses serious threats to satellites and space environment, but also to humans in space and on Earth. Space debris has become a major concern requiring a rapid and efficient response from States in order to combat the effects of space pollution and ensure the continuity of space activities and the preservation of the outer space environment². It is however not the first time that the international community faces a pressing need to take action to protect the environment. International environmental law has developed immensely over the past decades, with sustainable development and fundamental principles at its core³. This article thus proposes to examine the following question: how can concepts and principles of international environmental law serve as inspiration in developing a regulatory system to address the issue of space debris?

§3 The initial assumption of this study is that a (re-)formulation of principles in a framework convention applying to space activities and aimed at ensuring sustainable development and environmental protection in outer space can lay the foundations to guide further action and implementation, reinforce existing mitigation guidelines and lead to the establishment of an efficient, more detailed regulatory system for the removal of space debris.

§4 Of course, regulation of space debris involves serious and complex political questions. Tensions between spacefaring and non-space faring, or developed and developing nations for instance, are made evident in official reports of sessions of the United Nations Committee on the Peaceful Uses of Outer Space⁴ or its Subcommittees⁵, and confirmed by space law experts⁶. While this article does not intend to ignore the political, economic and geopolitical interests at stake, its main focus will be on legal aspects. In that regard, it takes a rather normative stance,

considering - maybe hoping - that States' conduct and actions can be guided and regulated by legal principles and conventions.

Another limit of this article is its relative shortness. Accordingly, it does not claim to provide a complete and in-depth analysis of international space law or environmental law, but merely to initiate and stimulate reflexion by examining the relevance of, and role that could be played by, concepts and principles derived from environmental law to address the issue of space debris.

§5 This article will start by defining space debris and the threats it poses, as well as assessing the current legal framework relating to space debris in the context of international space law. The relevance and interest of drawing a parallel with environmental law will then be explained, in order to examine how sustainable development and related principles of environmental law could be further adapted to the context of space law. Finally, an attempt will be made to detail the impact of principles derived from international environmental law by highlighting their functions as well as more specific roles in the contexts of space debris mitigation and remediation measures.

Space Debris and International Space Law

§6 Space debris is increasingly considered as a serious and pressing matter that requires efficient action on the part of States. However, it is also a complex topic and, in order to conduct a relevant analysis of it, it is important to properly comprehend the intricacies and context of the issue.

Space Debris: Definition

§7 Although there is increasing concern and debate about space debris at the international level, no international legal instrument defines the term “space debris”⁷. The Inter-Agency Space Debris Coordination Committee has developed a definition of space debris as referring to “*all man-made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional*”⁸. Although other definitions exist⁹, their content is essentially the same and the definition of the Inter-Agency Space Debris Coordination Committee has been endorsed by the United Nations Committee on the Peaceful Uses of Outer Space¹⁰, which is considered as the main forum in which countries gather to discuss issues related to activities in outer space¹¹.

§8 The different types of space debris are usually grouped into four categories: inactive payloads, operational debris, fragmentation debris, and micro-particulate matter¹². Inactive or inoperative payloads consist of satellites and spacecraft which have become derelict and cannot be controlled by operating entities on Earth, while operational debris refer to mission-related objects and rocket bodies which are released during the launch of a satellite and discarded when they are no longer in use. Fragmentation debris arise from in-orbit break-ups due to explosions, collisions and accidents in space, and micro-particulate matter is generated from shedding of the surface of in-orbit objects and manned spacecraft due to the extremely hostile environment in space¹³.

More concretely, space debris includes objects as diverse as satellites that are no longer in use, parts of space objects which have been ejected or fragments resulting from explosions and collisions, tools used during space walks, garbage dumped by manned missions, or even flakes of paint¹⁴.

The Problem with Space Debris

§9 The exploration and use of outer space by humankind has led to a multiplication of space objects in orbit, with about 9600 satellites being placed in Earth orbit since the dawn of the space age¹⁵. However, according to the U.S. Space Surveillance Network, only about 6 per cent of the space objects that it is able to

track are active, the remaining 94 per cent thus constituting space debris¹⁶.

There is overwhelming scientific evidence that indicates that the increasing presence and production of space debris poses a significant threat in at least two ways.

§10 First, the growing population of debris leads to an increase in the risk and frequency of collisions with functioning space objects, which could have the effect of destroying or disabling space-based resources¹⁷. Even very small, sometimes untraceable space debris poses a significant threat to space objects and astronauts due to their high velocity and can cause catastrophic damage to – potentially manned – spacecraft by puncturing it and incapacitating it partially or totally¹⁸. In September 2020, it was reported that the International Space Station had had to carry out an avoidance manoeuvre for the third time since the beginning of the year in order to avoid a collision with space debris¹⁹. Manoeuvres by satellites to avoid collisions with space debris require extra fuel which can become costly²⁰ and, by definition, only concern operational and controllable space objects; collisions between space debris cannot be avoided as the debris cannot be controlled. Several studies have indicated that the situation of space debris has already reached a “tipping point” as the debris population will continue to collide with itself, growing exponentially and thereby exponentially increasing the risk of failures for spacecraft²¹.

This phenomenon, known as the Kessler effect²², had already been identified in 1978 when NASA scientists Donald J. Kessler and Burton G. Cour-Palais predicted that fragments created by satellite collisions would provoke further collisions, and that an exponential increase in the number of debris due to those collisions would eventually result in the creation of a “belt of debris” around the Earth²³. In recent years, the international community has grown more aware of this situation, and it is understood that mitigation measures and operations aimed at decreasing the amount of space debris should be undertaken sooner rather than later as any further delay in their commencement will render them less effective and more costly²⁴.

§11 Another risk resulting from the increasing presence of space debris is that of re-entry into the atmosphere, potentially causing damage to the general public on Earth²⁵. There have already been several reports of space objects returning to Earth and impacting the ground or the oceans²⁶. Although no human fatalities have been confirmed so far, the risk of a returning debris causing personal injury to an individual exists and has been estimated to be on the order of one in ten thousand²⁷.

§12 Space debris re-entering the atmosphere and crashing on Earth also

constitutes environmental pollution as such, as fragments can be scattered in several locations and disintegrate over many years²⁸.

Current Framework Relating to Space Debris

§13 In spite of the threats that space debris poses to present and future space operations, human life on Earth and the environment in general, the issue is not addressed in any existing international treaty.

The main treaty in the field of space law, often referred to as the “constitution” of international space law, is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies²⁹ (hereinafter referred to as the “Outer Space Treaty”). The Outer Space Treaty was negotiated and opened for signature in 1967, in the context of the Cold War³⁰. At the time of drafting of the Treaty, space was considered to be destined for scientific and military uses, and of these, the emphasis placed on protecting scientific exploration is made evident through the principle of freedom of use and exploration enshrined in Article I.2 of the Treaty³¹. Peaceful use of outer space, issues of weaponization, cooperation amongst States and the principle of non-appropriation of space were the primary focusses of the Treaty³².

§14 The Outer Space Treaty reflects a very anthropo-centric vision of outer space³³, and little attention is given to environmental issues. The environmental aspect of space is vaguely mentioned in Article IX of the said treaty, which provides that States must conduct their exploration of outer space “so as to avoid harmful contamination [of outer space] and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter”.

Article IX thus introduces the concepts of forward and backward contamination, which refer respectively to pollution of outer space due to human activities (forward contamination), and environmental effects on Earth resulting from the introduction of extra-terrestrial matter in the atmosphere (backward contamination)³⁴.

However, although the article seemingly addresses both types of contaminations, most of its provisions concentrate on the backward one and for the most part ignore forward contamination³⁵. Moreover, the article’s terms are vague and undefined. Some argue that the word “contamination” refers to harm caused to outer space through the release of chemical effluents and that space debris do not fall under the scope of Article IX³⁶.

§15 Subsequent treaties governing human activities in outer space are the

1968 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (hereinafter “the Rescue Agreement”)³⁷, the 1972 Convention on International Liability for Damage Caused by Space Objects (hereinafter “the Liability Convention”)³⁸, the 1975 Convention on Registration of Objects Launched into Outer Space (hereinafter “the Registration Convention”)³⁹, and the 1979 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (hereinafter “the Moon Agreement”)⁴⁰. None of these instruments satisfactorily address the issue of space debris. The Moon Agreement contains more advanced provisions relating to the space environment - it enshrines the concept of “common heritage of mankind” and prescribes equitable sharing of benefits⁴¹ -, but it is almost irrelevant⁴² as it has gathered only eighteen ratifications as of today, all from States which do not conduct independent launch activities⁴³.

§16 To fill the gap and address the urgent threat posed by space debris, rules and principles have been developed outside of international conventions, by States as well as international agencies and bodies⁴⁴. In 2002, the Inter-Agency Space Debris Coordination Committee adopted Space Debris Mitigation Guidelines (hereinafter referred to as “the IADC Guidelines”)⁴⁵. These guidelines aim at advising States about technical aspects of debris mitigation and reflect “the fundamental mitigation elements of a series of existing practices, standards, codes and handbooks developed by a number of national and international organizations”⁴⁶. They are based on three main principles: (i) preventing on-orbit break-ups, (ii) removing space objects that have reached the end of their missions from the useful densely populated orbit regions and (iii) limiting the number of objects released during launches and space operations⁴⁷.

In order to minimise the risk of on-orbit break-ups and ensuing damage to other spacecraft, the guidelines recommend the passivation - in other words the elimination - of all on-board sources of stored energy of a spacecraft or orbital stage when they are no longer needed⁴⁸. Another recommendation is post-mission disposal of spacecraft when their operational phases are ended, by re-orbiting them to another orbit or de-orbiting them⁴⁹, depending on whether they are situated in the Geostationary Earth Orbit (GEO)⁵⁰ or the Low Earth Orbit Region (LEO)⁵¹, which are protected regions for the purposes of the IADC guidelines. In the case of space objects orbiting in LEO, the guidelines suggest a 25-year post-mission orbital lifetime limit before spent space objects are de-orbited⁵².

§17 The IADC guidelines served as a model for the Committee on the Peaceful Uses of Outer Space’s *Space Debris Mitigation Guidelines*⁵³ in 2007. These constitute one of the most important sets of guidelines regarding space debris mitigation as they were adopted when the Committee represented 67 States, highlighting a general international consensus among space faring nations in that

regard⁵⁴. The guidelines of the Committee on the Peaceful Uses of Outer Space were subsequently endorsed in a Resolution of the United Nations General Assembly⁵⁵, which further contributed to emphasizing their central role and high political value⁵⁶.

§18 In June 2019, the Committee on the Peaceful Uses of Outer Space, which represented 87 States at the time, adopted the Preamble and 21 Guidelines for the Long-Term Sustainability of Outer Space Activities⁵⁷. The objective of the Guidelines is worded as follows:

“to support States in engaging in activities aimed at preserving the space environment for the exploration and use of outer space for peaceful purposes by all States and international intergovernmental organizations”⁵⁸

The guidelines are grouped into four categories: policy and regulatory framework for space activities, safety of space operations, international cooperation, capacity-building and awareness, and scientific and technical research and development.

§19 However, even if they benefit from wide adhesion and endorsement, these guidelines are not legally binding⁵⁹ and there is no mechanism to enforce obligations in case a State fails to respect the recommendations⁶⁰. Although it has been observed that the guidelines are used by many States to set their own standard of conduct⁶¹, and that standard practices on average have improved⁶², a single large event can negate the progress made during years of successful mitigation efforts⁶³. Moreover, recommendations for mitigation only concern space objects that are likely to further increase the amount of space debris in the future; it does not offer a solution regarding the very large, already existing and problematic population of space debris already in orbit. A study published by the European Space Agency in 2017 stated that:

“the goal of the mitigation guidelines - to preserve the Earth environment for future generations - is still beyond reach”⁶⁴.

§20 Even a highly meticulous implementation of the guidelines by all actors would therefore not be sufficient to properly address the issue of space debris. In addition to mitigation efforts and implementation of the guidelines, it is becoming increasingly acknowledged that actual remediation operations - such as active debris removal - are also necessary to avoid the threats summarised above⁶⁵.

Drawing a Parallel with, and Inspiration from, International Environmental Law

§21 In contrast with the issue of space debris, environmental law has developed over the years to establish principles and mechanisms to deal with environmental problems on Earth. However, as such, principles of (terrestrial) environmental law are not always adapted to the context and specificities of space law and thus do not offer the most efficient framework to address issues such as space debris. It is thus interesting to examine these principles and determine to what extent, and how, they could be (more) relevant in the context of space law.

International Environmental Law: Considerations of Relevance

§22 In order to develop a regulatory system to properly address the issue of space debris, it is interesting to draw inspiration from international environmental law⁶⁶. Many similarities exist between environmental law and general space law, and more specifically between the issue of space debris and terrestrial environmental challenges.

§23 In both fields, many different actors are concerned and involved in discussions. Although the diversity of actors and interests, and especially the role played by non-state actors, is more visible in the context of environmental law⁶⁷, space law is also becoming less of a “State-only” matter⁶⁸. The multiplicity of actors and stakeholders leads to numerous political, economic and societal issues that must be taken into account⁶⁹.

§24 Another essential feature of international environmental law and space law is the transboundary, and even global, character of the issues they are faced with and of the consequences that their degradation entail for humankind in general. Similarly to (at least some aspects of) the environment on Earth⁷⁰, outer space can be viewed as a “global commons”. This conception is at the heart of the Outer Space Treaty itself, which establishes that space must be “free for exploration and use by all States” and prohibits the appropriation of space or celestial bodies⁷¹. The counterpart of this freedom is the fact that, as stated in the context of environmental issues, “states’ interdependence in terms of both contributions and solutions demands cooperation in addressing collective environmental concerns”⁷². It is broadly agreed that the action of only one actor would thus be insufficient to address the issues, and that coordinated action is required⁷³.

§25 Environmental law, or some elements thereof, are thus relevant to the context of space activities, and of space pollution more specifically. One must however

bear in mind the significant differences that also exist. For instance, and contrary to most human activities on Earth, any missions in outer space may be considered as ultra-hazardous. Furthermore, damage caused to the space environment can present other types of difficulties: the identification of the actor at fault in case of collisions by space debris or cumulative effects, the evaluation of the damage caused and the financial compensation that should follow can prove to be complex questions that may require a different approach than can be used for terrestrial damage⁷⁴. In addition, as developed above, the space environmental concerns addressed in this article are very anthropo-centric in that they relate more to man-made objects that are in orbit or could land on Earth rather than to the space environment as such. However, it is only in recent years that environmental law has started to protect the environment as such and not just preserve it for the use and exploitation of mankind, so a move towards the protection of the space environment *per se* might also occur in the following years or decades.

Principles of Environmental Law: Traces and Development in the Context of Space Law

§26 The concept of sustainable development is central in international environmental law⁷⁵. Although it existed prior to 1987, sustainable development first started to emerge as an important concept when it was given a definition by the World Commission on Environment and Development in its “Our Common Future” report⁷⁶. Sustainable development was later highlighted as a central goal for the international community in the 1992 Rio Declaration on Environment and Development and is mentioned in multiple international instruments today⁷⁷.

According to definition of the World Commission on Environment and Development, sustainable development is development “that meets the needs of the present without compromising the ability of future generations to meet their own needs”⁷⁸. The notion is often understood to comprise three main principles: integration, intergenerational equity and intragenerational equity⁷⁹. The requirement of integration is expressed in Principle 4 of the 1992 Rio Declaration⁸⁰ and refers to the need to “reconcile economic development with protection of the environment (...)”⁸¹, by including economic and even social considerations in the development of environmental protection, and vice versa⁸².

§27 The principle of integration is considered as essential to achieve the inter- and intragenerational equity which are set out in Principle 3 of the Rio Declaration⁸³. Intergenerational equity refers to the duty to preserve the environment for future generations and, in that regard, accounts for the part of sustainable development that is more focused on environmental protection and preservation as such⁸⁴. As for intragenerational equity, its focus is on equity in the distribution of the outcomes of development among current States and especially emphasises the

right to economic development of developing countries⁸⁵. In that sense, it can be considered as reflecting the need for fair economic and social development within the sustainable development notion⁸⁶.

Similar concerns about preservation of outer space for future use and research⁸⁷, as well as ensuring equal access to, and benefit from, the resources of outer space for all⁸⁸, have been voiced and sustainable development seems to have emerged as a concern in the field of international space law as well. In 2019, the Committee on the Peaceful Uses of Outer Space indeed agreed on additional guidelines focusing on the long-term sustainability of outer space activities, which refers to the “ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations”⁸⁹.

§28 Some authors argue that elements of sustainable development can already be found in the 1967 Outer Space Treaty. The principle of intergenerational equity seems to be reflected in Article I’s mention of outer space as a “province of all mankind”, which includes an aspect of preservation of the environment⁹⁰. Furthermore, the preamble of the Outer Space Treaty acknowledges “the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes” and states that “the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development”⁹¹. The language of the preamble can thus be considered to coincide with the principle of intragenerational equity.

§29 There exist other substantive and procedural principles of environmental law which are related to sustainable development and prove relevant to this analysis⁹². Due to its limited length, this article does not claim to analyse these principles and the different questions surrounding them in detail. Rather, the aim below is to briefly describe the content of these principles in order to examine their relevance in the context of outer space activities. However, it cannot be stressed enough that the endorsement of general principles involves political decisions⁹³, which are not the subject of this study but must be kept in mind.

The Principle of Sustainable Use

§30 The principle of sustainable use and conservation of resources appears as an emerging principle in the context of sustainable development⁹⁴ and is embodied in Principle 8 of the Rio Declaration⁹⁵. According to the International Law Association’s New Delhi Declaration of Principles of International Law Relating to Sustainable Development:

“States are under a duty to manage natural resources (...) in a rational, sustainable and safe way so as to contribute to the development of their peoples (...) and to the conservation and sustainable use of natural resources and the protection of the environment (...). States must take into account the needs of future generations in determining the rate of use of natural resources”⁹⁶.

§31 The New Delhi Declaration further states that: “the resources of outer space and celestial bodies and of the sea-bed, ocean floor and subsoil thereof beyond the limits of national jurisdiction are the common heritage of humankind”⁹⁷. It is worth mentioning however that the concept of outer space as a “common heritage of mankind” is very controversial. Its endorsement in the Moon Agreement led to the refusal of many spacefaring countries to sign it, making the convention almost irrelevant as discussed above⁹⁸. However, the general idea that outer space must be preserved is less contentious as it is closely linked with the principle of equity. Accordingly, the obligation contained in Article IX of the Outer Space Treaty for States to conduct activities in outer space “so as to avoid their harmful contamination” resonates, to a certain extent, with the principle of sustainable use and conservation of resources⁹⁹.

The Precautionary Principle

§32 Acknowledgement of the vulnerability of the environment and of the limitations of scientific knowledge and predictions is at the core of the precautionary principle¹⁰⁰. Set out in Principle 15 of the Rio Declaration¹⁰¹, it requires States to take precautionary measures in order to prevent possible environmental harm that could result from potentially damaging conduct, even when there is no full scientific certainty as to the actual existence of the threat to the environment¹⁰². Although there are some doubts regarding the exact scope and effects of the principle¹⁰³, it is generally accepted that it involves a credible non-negligible threat, a lack of scientific certainty or evidence regarding both the potential harm and the causality, and a duty to take action¹⁰⁴.

§33 These elements of the precautionary principle seem *prima facie* relevant in the context of space, as scientific knowledge of outer space is still evolving and there is a growing awareness amongst States of the irreversible and potentially grave nature of damage. The precautionary principle might have contributed to the evolution of States’ approach to outer space, from a presumption of freedom of use to a more conservation-oriented vision¹⁰⁵.

However, the application of the precautionary principle in the context of space

activities presents certain difficulties as most, if not all, operations taking place in outer space can potentially be regarded as ultra-hazardous¹⁰⁶. Moreover, given the increasingly plausible and widely accepted scientific evidence concerning the specific issue of space debris, the principle of precaution might not be the most relevant in this context.

The Prevention Principle

§34 Contrary to the precautionary principle, the prevention principle applies to situations in which there exist foreseeable, proven risks. The principle of prevention requires that States take active steps to prevent foreseeable risks and protect the environment¹⁰⁷. Traditionally, the prevention principle has been closely linked with the no-harm principle and good neighbourliness¹⁰⁸, and in that respect it imposes an obligation of due diligence incumbent upon States to take precautions in order to safeguard other States from damage¹⁰⁹. However, it is argued that the prevention principle has evolved beyond the mere avoidance of damage to other States and also encompasses protection of the environment *per se*¹¹⁰.

§35 Similarly to environmental law, treaty law relating to space activities initially focused on protecting States' interests and avoiding causing harm to other States, with an emphasis on cooperation and due regard¹¹¹. Article IX of the Outer Space Treaty states that "[i]n the exploration and use of outer space (...), States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space (...) with due regard to the corresponding interests of all other States Parties to the Treaty. (...)" and requires States to undertake consultations with States that could be affected before conducting potentially harmful activities in outer space¹¹².

§36 However, more recent 'soft-law' instruments regarding activities in outer space seem to be shifting ever so slightly from the focus on States' interests towards consideration and protection of the space environment. Regarding the issue of space debris more specifically, guidelines issued by the Inter-Agency Space Debris Coordination Committee and the Committee on the Peaceful Uses of Outer Space - although, as discussed above, remaining anthropo-centric in essence - concentrate more on the protection of the outer space environment as a whole rather than specific State interests and operations. In that regard, the 2019 *Guidelines for the long-term sustainability of outer space activities* refer explicitly to the necessity to "avoid harm to the space environment"¹¹³.

§37 The prevention principle thus appears to already be mirrored to some extent in instruments relating to outer space activities. A clear enunciation of that principle in the context of space law would promote the necessity for States to exercise due diligence regarding prevention and control when they conduct space activities by,

for instance, carrying out prior impact assessments, ensuring ongoing control as well as implementing mitigation recommendations set out in the guidelines of the Committee on the Peaceful Uses of Outer Space¹¹⁴.

The Principle of Common but Differentiated Responsibilities

§38 Embodied in Principle 7 of the Rio Declaration¹¹⁵, the principle of common but differentiated responsibilities finds its roots in the principle of equity examined above¹¹⁶. The principle is twofold: it asserts that States share a common responsibility to protect and preserve the environment as environmental problems are global, but also requires that each State's contribution to pollution and ability to prevent and reduce environmental harm should be taken into account¹¹⁷. The principle fosters substantive equality by recognising that activities conducted by industrialised countries generate more pollution and dictating that those States should bear the main burden of combatting the negative impacts of such pollution on the environment¹¹⁸. Furthermore, as developed countries possess more advanced resources and technologies to address environmental issues, they should assist developing States in doing so, and different standards in the pursuit of sustainable development must apply to countries depending on their capabilities and levels of development¹¹⁹.

§39 In the context of space, the global character of issues and the need for cooperation and partnership amongst States is clear. However, as discussed above, the divide between developed and developing countries can be viewed as at least equally prominent when it comes to outer space activities. Environmental degradation in outer space has by definition been caused by spacefaring nations, and it is mainly those nations which have the capacity to tackle the issue of space pollution. Non-spacefaring countries have expressed their concerns about the preservation of outer space for future space activities and fear that failure to act would entail irreversible harm¹²⁰. Consequently, non-spacefaring States consider that spacefaring, industrialised countries bear the responsibility of addressing the issue of outer space pollution¹²¹. Although there has been reluctance in the past on the part of developed countries to take action in the face of scientific uncertainty as to the environmental effects of space activities¹²², the endorsement of space debris mitigation measures can be considered to indicate a certain form of acceptance of the special responsibilities incumbent upon spacefaring nations.

The Polluter-Pays Principle

§40 The polluter-pays principle prescribes exactly what its name indicates: that the actors engaging in polluting or hazardous activities must bear the costs linked to the pollution, in terms of prevention, control, and repair of damage caused as a consequence of it¹²³. The principle is based on the premise that those costs should

not be borne by society at large¹²⁴. It is in essence an economic, cost-allocating principle to guide the policies implemented by public authorities vis-à-vis private actors generating pollution; as such, it is not meant to be implemented at the inter-state level and its application in the international context is therefore limited¹²⁵. Moreover, many consider that the principle lacks normativity due to the vagueness of its wording in Principle 16 of the Rio Declaration¹²⁶.

§41 In addition to these difficulties, the application of the polluter-pays principle may prove difficult in the context of space activities for more practical reasons: as discussed above, identifying the actor responsible for pollution and damage can lead to complex causation questions in cases where collisions - and therefore an increase in pollution of the space environment - were caused by space debris or result from a chain of cumulative events¹²⁷. Furthermore, assessing the actual polluting impact that space operations and debris have on the environment also proves difficult, and if it were to be assessed, the damage caused would likely exceed the reparatory capacities of any spacefaring entity¹²⁸. Making the polluter bear the costs of reparation for pollution in outer space appears very difficult to implement, and it has been considered that “tiered systems and collective loss-sharing arrangements” would be more adequate to “channel the risks of ultra-hazardous activities and ensure means for adequate indemnification for damages”¹²⁹. The polluter-pays principle thus appears to be less relevant than others in the context of international space law.

Environmental Impact Assessment

§42 Environmental impact assessment is a “procedure for evaluating the likely impact of a proposed activity on the environment”¹³⁰. It is set out in Principle 17 of the Rio Declaration¹³¹ and requires decision-makers to identify environmental risks, alternatives and mitigating measures, as well as integrate environmental considerations into socio-economic planning prior to authorising an activity to proceed¹³². Environmental impact assessment is merely a procedure allowing States to make informed decisions when assessing whether they should proceed with an activity or require further measures or research, and does not as such determine the outcome of the decision to be made by public authorities¹³³.

§43 The systematic implementation of such a procedure would seem relevant and beneficial in the context of space law, where the vast majority of operations are deemed to pose a significant threat to the environment. Requiring States to conduct an environmental impact assessment before proceeding with space operations would further the goal of sustainable development in outer space and, more specifically, contribute to the fulfillment by States of their obligation of due diligence with respect to the prevention principle¹³⁴. Certain States already organise types of environmental impact assessment procedures in their national

legislations¹³⁵. Furthermore, concerning space debris more specifically, the IADC Guidelines recommend that States establish a Space Debris Mitigation Plan for each program and project¹³⁶, which is in essence quite similar to an environmental impact assessment. The introduction of environmental impact assessment at the international level would thus likely be accepted by most States and would enhance the significance of these procedures at the domestic level.

Given that specific space projects creating debris result from broader pre-existing policies, it has also been suggested that instead of imposing procedures focusing on the environmental impact of specific operations, it would be more effective to address entire policies and strategies directly through strategic environmental assessments¹³⁷.

Cooperation between States

§44 Cooperation has been mentioned previously as a means to comply with different substantive principles, such as prevention and common but differentiated responsibilities. It is at the core of environmental law and is enshrined in Article 27 of the Rio Declaration which highlights the good faith and spirit of partnership in which States should cooperate¹³⁸. The strong interdependence characterising environmental issues entails the necessity of cooperation to control, prevent, reduce and eliminate the adverse effects of pollution by ensuring that efforts made by States are efficient and coordinated, through the exchange of information and consultation procedures¹³⁹. Cooperation between States also means that private actors are put on an equal footing as they are forced to play by the same, or at least compatible, rules¹⁴⁰.

§45 The necessity of cooperation is not contentious as such in the context of space law. The principle of cooperation and the obligations of notification and consultation that it encompasses were already recognised as early as 1967 in Article IX of the Outer Space Treaty¹⁴¹ and reaffirmed in the 2019 Guidelines for the long-term sustainability of outer space activities¹⁴².

§46 However, in the context of space debris, mere notification and consultation might appear inadequate as the pollution caused by debris cannot be equated to a transboundary risk affecting specific, identifiable States. The threats caused by space debris are of a global nature, so that international cooperation beyond notification and consultation might be desirable. The principle of cooperation through exchange of knowledge, technology and capacity-building as set out in Principle 9 of the Rio Declaration¹⁴³, highlighting certain requirements of developing countries in terms of access to development¹⁴⁴, may prove to be more useful in that regard. The benefit and necessity for States to cooperate in terms of research or access to technologies in the context of activities relating to outer

space have been discussed above. Furthermore, the importance of including developing countries in treaty development and capacity-building processes has been underlined by commentators who argue that such inclusion would promote equality and equity among States, build trust and peaceful cooperation and increase adherence to rules and standards of international space law¹⁴⁵.

In that respect, it is worth noting that the 2019 Guidelines of the Committee on the Peaceful Uses of Outer Space recommend that “States and international intergovernmental organizations with experience in space activities should encourage and support capacity-building in developing countries with emerging space programmes”, through the sharing of expertise and knowledge, the gathering of human and financial resources and the accessibility of data¹⁴⁶.

Public Participation and Access to Information and Justice

§47 Sustainable development also implies the involvement of the public at large in the handling of environmental issues. Obligations of transparency, public participation and access to justice are embodied in Principle 10 of the Rio Declaration¹⁴⁷, and further developed in the ILA Declaration of Principles of International Law Relating to Sustainable Development as essential components of sustainable development¹⁴⁸. Involvement of civil society is deemed essential to ensure that government policies properly promote environmental justice, take into account present and future generations, integrate environmental considerations in decisions relating to socio-economic development and implement environmental law standards and obligations¹⁴⁹. These procedural rights are also closely linked with the human right to a clean environment¹⁵⁰.

§48 International space law does not seem to devote much attention to procedural rights of the public in relation to environmental issues in outer space. However, as discussed above, an improper handling of the issue of space debris could seriously affect human populations on Earth and long-term sustainability of resources. Civil society might have a greater role to play by putting pressure on governments to take action and comply with international standards. In that respect, Guideline C.4 of the 2019 guidelines of the Committee on the Peaceful Uses of Outer Space encourages States to raise public awareness about space activities, but focuses more on the “important societal benefits” of space activities than on the environmental threats posed by space debris¹⁵¹.

Impact of Principles of Environmental Law Adapted to the Context of Space Debris

§49 It appears from what has been developed above that the principles and elements drawn from environmental law and adapted to the context of space may provide some help in addressing the issue of space debris. These adapted principles, enunciated in a framework convention aimed at ensuring sustainable development and protection of the outer space environment, could have an impact both in terms of mitigation and remediation of space debris.

Legal Status and Functions of Sustainable Development and Related Principles

§50 The legal status of sustainable development and principles of environmental law relating to, or deriving from, that concept, is a topic that has been much discussed and does not seem to be settled. While some of these principles might have strong claims to customary status and would thus be binding on all States, such assertions remain contentious and for the most part unresolved¹⁵². Another view is that these principles may constitute general principles of law, not binding as such but still part of the *corpus* of international law¹⁵³. This article does not claim to bring a solution to that controversy. Whatever their legal status may be, it is widely acknowledged that principles play a prominent role in international environmental law¹⁵⁴. The ways in which principles impact environmental law can be summarised in three main functions.

§51 The first function of principles in environmental law is that of normativity. While the flexible and vague formulation of these principles might prevent them from imposing absolute obligations to realise specific actions or reach clear-cut goals, they are still normative in the sense that they impose obligations of means¹⁵⁵. States are bound to try to respect principles of environmental law, and their decisions must be the outcome of a process which promotes sustainable development¹⁵⁶. Sustainable development and related principles can thus be considered as adding to the normativity and effectiveness of more specific norms that fall within their scope¹⁵⁷.

§52 Another crucial function of principles of environmental law is to set objectives and guide future actions and measures¹⁵⁸. Irrespective of the legal nature of sustainable development, it establishes a framework, a policy influencing the practice of States and the development of law¹⁵⁹. In that regard, Bodansky states that “international environmental norms can play a significant role by setting the terms of the debate, providing evaluative standards, serving as a basis to criticize other states’ actions, and establishing a framework of principles within which

negotiations may take place to develop more specific norms, usually in treaties”¹⁶⁰.

§53 The third and final function that has been highlighted by commentators is that of interpretation, as judges may rely on the concept of sustainable development or certain principles of environmental law to determine the meaning of specific treaty provisions¹⁶¹.

§54 In this article, it is argued that principles of environmental law adapted to the context of space law - enunciated in a framework convention on sustainable development in outer space - are relevant and would play an important role in addressing the issue of space debris. The two first functions of these principles - namely adding normativity to existing rules and providing direction for future action - prove to be especially suitable and useful in that regard.

Reinforcing the Normativity and Implementation of Mitigation Measures

§55 The normative function of a clear body of principles addressing the environmental aspects of space activities would reinforce the adherence to, and promote the further implementation of, space debris mitigation guidelines.

§56 The paramount importance of measures for mitigating space debris has already been mentioned above. The fact that the Guidelines drafted by the Inter-Agency Space Debris Coordination Committee and the Committee on the Peaceful Uses of Outer Space are not binding has led to concerns that “a ‘tragedy of the commons’ situation may arise wherein actors adhering to the measures are at a competitive disadvantage when foreign competitors do not have to comply with regulations”¹⁶².

Although, in practice, the mitigation guidelines benefit from a wide adherence amongst spacefaring nations, their implementation could still be improved. In 2017, a report published by the European Space Agency aiming to quantify and assess the level of adherence to the IADC guidelines stated that:

“The level of adherence 15 years after the introduction of the mitigation guidelines is sobering (...). The environment around Earth (...) is continuing to get more hostile almost every year. The goal of the mitigation guidelines

- to preserve the Earth environment for future generations - is still beyond reach”¹⁶³.

A high degree of compliance by States to the mitigation guidelines is essential, and

is fostered partly by the fact that the guidelines draw from fundamental elements of already existing practices and standards adopted by States and organisations involved in space activities¹⁶⁴.

§57 However, in the absence of any coercion system – as is the case in space law –, the obligatory force of an instrument also rests upon its legitimacy in the eyes of those to whom it is addressed¹⁶⁵. In this regard, the development of a framework addressing the environmental aspects and sustainability of space activities would provide a more solid basis for the legitimacy and authority of mitigation guidelines.

§58 Furthermore, the actual implementation of the guidelines could be facilitated by applications of the principle of cooperation such as the creation of a clearing-house mechanism. Such a mechanism would promote capacity-building and the sharing of information and knowledge amongst States regarding cost-efficient technology complying with mitigation guidelines. Similarly to the clearing-house mechanism for the Convention on Biological Diversity¹⁶⁶, it could also increase public awareness through education and training programmes, promoting public participation and ensuring access to information on matters relating to space debris. A better-informed civil society would increase pressure on governments to be mindful of space environment by respecting mitigation guidelines, and even foster research efforts and technology development to do so.

The systematic implementation of a procedure similar to an environmental impact assessment, requiring that States verify that space-related projects – or even entire policies – comply with mitigation standards prior to authorising them, could also assist in the implementation of mitigation measures.

Principles as Guides for Future Action: Remediation

§59 In addition to the need for a systematic and widespread implementation of mitigation measures, there is a growing understanding among States and non-governmental actors that the conduct of remediation operations is also becoming essential in order to address the increasingly pressing issue of space debris¹⁶⁷. The necessity of remediation measures was very clearly emphasized in a 2012 Report of the of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing within the Committee on the Peaceful Uses of Outer Space:

“The space debris mitigation guidelines focus on, and emphasize the mitigation (or reduction) of the rate at which new pieces of space debris are generated during the conduct of space activities. However, in view of the massive amount of debris already in existence in Earth orbit, growing consensus among experts suggests that an active process for the removal of existing debris from space and for on-orbit servicing of satellites is required in addition to the mitigation efforts

in order to protect the space environment and guarantee its sustainability in the long-term”¹⁶⁸.

§60 The development and implementation of practicable remediation measures, both at the national and international level, would be strongly supported by the adoption of a framework convention enshrining key principles for sustainable development and protection of the outer space environment. As discussed, principles such as intra- and intergenerational equity, prevention, and common but differentiated responsibilities, require States to take action in order to preserve the environment in outer space and to take responsibility for their role in polluting it.

Although there is no lack of ideas for potential remediation measures¹⁶⁹, political and geopolitical interests, uncertainty of technological developments, financial concerns and legal considerations have constituted obstacles to the actual realisation of those ideas.

§61 A recurring proposition amongst researchers and experts attempting to find a solution to space debris is that of building a regulation based on the model of the law of salvage in maritime law. The law of salvage, formalised in the International Convention on Salvage in 1989¹⁷⁰, results from a concern for vessels and human safety, but also for the protection of the environment, and aims at encouraging persons (called “the salvor”) who voluntarily undertake to help recovering vessels that are in danger at sea¹⁷¹. In this context, danger is understood to encompass future or contingent danger, danger to third parties or danger to the environment¹⁷². If the result of the salvage operation is useful, the salvor is entitled to an award proportionate to the value of the property salvaged, the degree of success, the nature and degree of the danger, the risk of liability incurred by the salvor, and other factors¹⁷³. Article 14 of the Convention further provides that special compensation may be awarded if the vessel presented an environmental hazard, or if the salvage operation reduced or minimised damage to the environment¹⁷⁴.

§62 Some elements of this system could serve as a model for the establishment of a regulatory framework for the active removal of space debris, in light of, and in accordance with, the newly adapted principles of environmental law in space law. However, certain challenges specific to the space environment, such as liability in case of damage during a removal operation, jurisdiction and control over the recovered space debris, or intellectual property regarding space objects, remain and must be considered when extracting elements from maritime law¹⁷⁵. As already emphasized, many of the issues examined in this article involve significant

underlying political and economic questions and motives which must be noted but will not be elaborated on here. The following paragraphs will examine in more detail the legal hurdles in the way of basing an active debris remediation regime on the law of salvage in maritime law. Concurrently, the goal-setting function of principles will be highlighted in this context in order to explore how a strong set of principles in a framework convention regarding the space environment may facilitate overcoming these legal issues.

§63 The first issue that is often raised when discussing a system based on the law of salvage is that of jurisdiction and control over objects launched into space. Article VIII of the Outer Space Treaty states that “a State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object”¹⁷⁶, which also entails a right to exercise sovereignty over a space object¹⁷⁷. Accordingly, it has been argued that only that State may determine whether a space object is non-functional and thus constitutes space debris, as a seemingly useless space object from a technical point of view may still have some value to the launching State¹⁷⁸. Moreover, even if an object is recognised as space debris, the launching State still retains control and jurisdiction over it: “there is no right of salvage analogous to the right found in maritime law, which means that even though a satellite or some other space object may not be functioning, it does not imply that it has been abandoned by the nation that launched it”¹⁷⁹. The view has thus been expressed that the State of registry must give prior consent or authorisation for the removal of space debris to take place, as doing otherwise would amount to an intrusion into the jurisdiction and control of the launching State¹⁸⁰.

§64 Communication and collaboration amongst States regarding space debris removal operations would be strongly promoted by the principle of cooperation enshrined in a framework convention. As it would be derived from concerns for the environment in outer space - and more specifically the serious threats entailed by space debris -, the principle of cooperation would weigh more heavily on States. The UN General Assembly, in its 1970 Resolution on co-operation among States, draws a distinction between matters such as international peace, security and economic stability on the one hand, and issues relating to science and technology on the other hand¹⁸¹. Only in the first branch is there a real duty for States to cooperate. Given the major threats that space debris represent in terms of national and international security and preservation of economic and social interests, cooperation among States in the context of debris removal would not only be encouraged, but required by a strong principle of cooperation.

In more concrete terms, specific procedures to enable the exchange of information and consultation could be set up in a more detailed protocol on space debris remediation, to be attached to the framework convention. The creation of a clearing-house mechanism, as mentioned above, could allow States to

communicate and exchange information regarding the status and specificities of space debris by, for example, establishing a global comprehensive correlated catalogue of space objects and debris¹⁸². On top of providing relevant technical information about space debris, a political consultation procedure could be envisaged, associated with the clearing-house mechanism, that would require States to initiate consultations with the State of registry prior to conducting a debris removal operation¹⁸³.

Another system that has been suggested is that of a Global Economic Fund for Space Debris Removal to which launching States and private actors would contribute in proportion to their share of activities in space, and which would provide funding to licensed removal entities¹⁸⁴. In a spirit similar to that of the law of salvage, the compensation granted could depend on the number of kilograms of debris removed¹⁸⁵. This mechanism could allow States to communicate regarding space debris removal, and to give their consent to debris removal operations by specific licensed entities, or even develop more innovative solutions such as a temporary transfer of certain aspects of the jurisdiction over specific space debris for the purposes of the removal operation.

§65 Another issue regarding active debris removal based on the law of salvage model is that of liability. The 1972 Liability Convention organises a two-pronged regime: while launching States incur strict liability for damage caused by a space object on the surface of the Earth or to an aircraft in flight, liability in case of damage occurring in space is fault-based and negligence must be proved¹⁸⁶. Moreover, Article IV provides that if damage caused by one State to another State's space object leads to damage of a third party, the launching States of both space objects that caused damage to the third party will be jointly and severally liable to the third State¹⁸⁷. As active debris removal operations most often involve the crossing of orbits and re-entry into the atmosphere, risks of damage and ensuing liability are heightened, with the effect of discouraging States from conducting such operations¹⁸⁸.

In this respect, it has been suggested that it may be desirable for States to reach an agreement to mitigate fault if damage occurs in the context of space debris removal operations, or even create an exemption from the scope of application of the Liability Convention¹⁸⁹. Such an agreement would be promoted and facilitated by explicit recognition of the need for sustainable development in outer space, and could be included in the aforementioned protocol regarding space debris removal. Environmental considerations would have to be integrated into economic concerns regarding damage and liability so that, on balance, an exemption from liability for actions aimed at protecting and preserving the environment for current and future generations could be agreed to as it would benefit the whole of humankind. Such an exemption could apply, for instance, to removal operations conducted in the context of agreements made within a clearing-house mechanism or the Global

Economic Fund for Space Debris Removal.

§66 Finally, issues relating to national security and intellectual property have been emphasized, as successfully approaching a space object in order to remove it would require detailed knowledge about that object, which might involve confidential or proprietary technical information as well as patents¹⁹⁰. The exchange of such information may thus require the signing of licensing and nondisclosure agreements. As mentioned above, the principle of cooperation in the context of the preservation of outer space environment can play a great role in promoting - or even imposing - communication and sharing of information among States, such as through a clearing-house mechanism or a Global Economic Fund for Space Debris Removal.

§67 In conclusion, it appears that the law of salvage model in maritime law would not be entirely transferrable to the context of space debris removal. As discussed, space debris do not constitute abandoned property as such, and prior consent from a launching State to the removal would be contrary to one of the fundamental elements of salvage, namely the voluntariness of the operation, taking place outside any prior or pre-existing contractual relationship¹⁹¹. However, the law of salvage provides a good basis for identifying some of the key legal issues that arise in the context of active debris removal carried out by States and actors other than the debris' launching State, and for examining how a clear and strong enunciation of sustainable development and related principles in a convention can support the action of States and the development of a regulatory framework for space debris.

Conclusion

§68 In the recent years, an increasing number of reports have confirmed concerns about the seemingly ever-growing population of space debris eventually creating a “debris belt” around the Earth, rendering further activities in space extremely difficult, if not impossible, and potentially causing damage upon re-entry into the atmosphere.

§69 The aim of this article was to examine to what extent, and how, principles of international environmental law could serve to address this increasingly pressing and concerning issue. Elements of sustainable development and related principles are already noticeable in major instruments and guidelines of space law, and could, for the most part, be further developed in a way relevant to space activities. Although not entirely or directly transferrable from (terrestrial) environmental law to space law given the specificities of each field, principles such as inter- and intragenerational equity, integration, sustainable use, prevention, common but differentiated responsibilities, environmental impact assessment, cooperation, or public participation and access to information, could be adapted and better applied in the context of space activities to support both mitigation and remediation of space debris.

There is no consensus among the international community as to whether a comprehensive binding instrument is needed to address the issue of space debris¹⁹², or if guidelines are sufficient in view of the political stakes and uncertainties relating to the development of technology¹⁹³. This study has argued that a framework convention / protocol approach would be most adequate to lay solid foundations for the regulation of the issue of space debris, given the highly political and economic stakes involved¹⁹⁴.

§70 Objectives of sustainable development as well as clear and strong principles deriving from environmental law should be adapted in a relevant way and formulated in a framework convention for outer space. Although they might not be directly implementable or binding due to their general character, the principles enshrined in such a convention would enhance the obligatory nature of debris mitigation guidelines and provide a strong basis for the development of more specific and binding remediation mechanisms. Indeed, such a convention would force States to approach activities in outer space with a different viewpoint, giving more weight to environmental considerations. In turn, more detailed standards and instruments that may result would give content and effect to the principles, fostering their implementation¹⁹⁵.

For instance, a protocol to the convention could be adopted to define key aspects of space debris remediation, by providing a definition of space debris or

procedures to do so, determining a more adequate rule regarding jurisdiction over space debris and potential transfer thereof, or establishing an appropriate liability regime for removal operations. Global schemes could also be set up to promote cooperation and implementation of efficient remediation measures, such as a clearing-house mechanism or a fund for licensed removal operations. The centralisation of data and overview of the progress made by all the different actors through those mechanisms would facilitate access to information by the general public. This heightened transparency and availability of information would be beneficial to civil society groups, which might have a crucial role to play by raising awareness and putting pressure on governments to act.

§71 The focal role of political decision-making and economic constraints has been highlighted at different steps of the reasoning. Space activities have a highly strategic function for States' security, military and commercial interests¹⁹⁶. Spacefaring nations may be unwilling to invest large efforts to ensure mitigation and remediation of space debris, and to cooperate too closely with others in that matter. On the other hand, the "tragedy of the commons" aspect of the space debris issue may lead spacefaring states to be more cooperative in order to preserve a resource upon which they heavily rely¹⁹⁷. In any event, as mentioned in the introduction, this study takes a normative stance and posits that explicit and coherent principles can strongly encourage cooperation and guide States' actions in dealing with the pressing and globally threatening issue of space debris.

§72 Although the entire international community may not readily come to an agreement on a complete and coherent set of principles for the environment of outer space, some States could take the initiative and it is likely that others will progressively join. Humorously referred to by some as the "Nike doctrine", the appeal for States to initiate actions independently gives those States an opportunity to appear as leaders in the field and responsible (spacefaring) nations¹⁹⁸. It has also been argued that developing countries may have an important role to play in the development of regulations relating to space debris, to foster and support equity and preservation of outer space. Unilateral declarations could be made by States about the principles they will respect and the responsibilities they will take and, as the consensus becomes increasingly evident, a formal convention could eventually be agreed upon. As the threats posed by space debris seem to be materialising and the leeway for action appears narrower than ever, such initiatives might be necessary to ensure that the expression "the sky is the limit" does not take on a much more sinister meaning.

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36. Gupta V., *op. cit.*, p. 26. ↵
37. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, opened for signature in London, Moscow and Washington, 22 April 1968, *U.N.T.S.*, Vol. 672, p. 119. ↵

38. Convention on International Liability for Damage Caused by Space Objects, opened for signature in London, Moscow and Washington, 29 March 1972, *U.N.T.S.*, Vol. 962, p. 187. ←
39. Convention on Registration of Objects Launched into Outer Space, opened for signature in New York, 14 January 1975, *U.N.T.S.*, Vol. 1023, p. 15. ←
40. Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, opened for signature in New York, 18 December 1979, *U.N.T.S.*, Vol. 1363, p. 3. ←
41. Gupta V., *op. cit.*, p. 31. ←
42. Viikari L., "Environmental aspects of space activities", in von der Dunk F. and Tronchetti F. (eds.), *Handbook of Space Law*, Cheltenham, Edward Elgar Publishing, 2015, p. 726. ←
43. The parties to the Moon Agreement, in March 2019, were: Armenia, Australia, Austria, Belgium, Chile, Kazakhstan, Kuwait, Lebanon, Mexico, Morocco, the Netherlands, Pakistan, Peru, the Philippines, Saudi Arabia, Turkey, Uruguay and Venezuela. ←
44. See the *Compendium of space debris mitigation standards adopted by States and international organizations*, Legal Subcommittee of the UNCOPUOS, Fifty-fifth session (4-15 April 2016), A/AC.105/C.2/2016/CRP.16 (2016). ←
45. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, September 2007. ←
46. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, September 2007, n° 15. ←
47. Li L., *op. cit.*, p. 303; McCormick P. K., *op. cit.*, 806. ←
48. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, September 2007, section 5.2.1. See also McCormick P. K., *ibidem*, p. 806. ←
49. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, sections 5.3.1 and 5.3.2. See also Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 94-95. ←
50. The Geostationary Earth Orbit is an "Earth orbit (...) whose orbital period is equal to the Earth's sidereal period. The altitude of this unique circular orbit is close to 35,786 km" (Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, section 3.3.2.). ←
51. The Low Earth Orbit Region (LEO) is a "spherical region that extends from the Earth's surface up to an altitude of 2,000 km" (Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, section 3.3.2.) ←
52. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, section 5.3.2. See also Hildreth S. A. and Arnold A., *op. cit.*, p. 8. ←
53. Report of the Committee on the Peaceful Uses of Outer Space on its fiftieth session (6-15 June 2007), GAOR, Sixty-second session, Supp. No. 20, A/62/20 (2007), Annex IV. ←
54. Li L., *op. cit.*, p. 304-305. ←
55. General Assembly Resolution 62/217, International cooperation in the peaceful uses of outer space, A/RES/62/217, 21 December 2007, para. 26. ←
56. von der Dunk F., *op. cit.*, p. 104. ←
57. Report of the Committee on the Peaceful Uses of Outer Space, UNCOPUOS, Sixty-second session (12-21 June 2019), A/74/20, Annex II ('Guidelines for the long-term sustainability of outer space activities'). ←
58. Guidelines for the long-term sustainability of outer space activities, para. 7. ←
59. McCormick P. K., *op. cit.*, p. 807; Hobe S. and Mey J. H., "UN Space Debris Mitigation Guidelines", in *German Journal of Air and Space Law*, Vol. 58, 2009, p. 395-396. ←
60. Gupta V., *op. cit.*, p. 34. ←

61. Murtaza A., Pirzada S. J. H., Xu T., Jianwei L., *op. cit.*, p. 61010; Popova R. and Schaus V., *op. cit.*, p. 55. ←
62. Viikari L., “Environmental aspects of space activities”, *op. cit.*, p. 757. ←
63. *Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris: A Report of the International Interdisciplinary Congress on Space Debris*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-eighth session (7-18 February 2011), A/AC.105/C.1/2011/CRP.14 (2011), p. 29. ←
64. Frey S. and Lemmens S., “Status of the space environment: current level of adherence to the space debris mitigation policy”, *Proceedings of the 7th European Conference on Space Debris*, Darmstadt, Germany, 18-21 April 2017, published by the ESA Space Debris Office, p. 7. ←
65. McCormick P. K., *op. cit.*, p. 803-804 and 809; Hildreth S. A. and Arnold A., *op. cit.*, p. 10; Inter-Agency Space Debris Coordination Committee, *Stability of the Future LEO Environment*, study by Liou J.-C., Rossi A., Krag H. *et al.*, IADC-12-08, Rev. 1, January 2013, p. 18. ←
66. According to E. Hey, international environmental law “aims to address the negative impacts that humans have on the environment with the objective of protecting and conserving the environment” (Hey E., *Advanced Introduction to International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2016, p. 1). It has developed in a rather reactionary, *ad hoc* manner to address specific issues after they appeared (Drumbl M. A., “Actors and law-making in international environmental law”, in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 15). ←
67. Ben-David M., “Defining International Environmental Law”, Review of the book *The Art and Craft of International Environmental Law* by Daniel Bodansky, in *Ecology Law Quarterly*, Vol. 38, No. 2, 2011, p. 554. See also Arts B., “Non-state actors in global environmental governance: New arrangements beyond the state”, in Koenig-Archibugi M. and Zürn M. (eds.), *New Modes of Governance in the Global System – Exploring Publicness, Delegation and Inclusiveness*, London, Palgrave Macmillan, 2006, p. 177-200; Drumbl M. A., *op. cit.*, p. 3-25. ←
68. One can but note the increasing presence and role of international organisations and private entities in matters relating to outer space (von der Dunk F., *op. cit.*, p. 107). ←
69. For international environmental law, see Ben-David M., *op. cit.*, p. 554 and 557. As for space law, the issue has been emphasized earlier in this paper. ←
70. Birnie P., Boyle A. and Redgwell C., *International Law and the Environment*, 3rd ed., Hampshire, Oxford University Press, 2009, p. 128; Ben-David M., *op. cit.*, p. 553. In the context of environmental law, E. Hey talks about “global interdependencies” (Hey E., *op. cit.*, p. 2-3). ←
71. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, p. 205, Articles 1 and 2. See also Popova R. and Schaus V., *op. cit.*, p. 55. ←
72. Bodansky D., Brunnee J. and Hey E., International Environmental Law: Mapping the Field”, in Bodansky D., Brunnee J. and Hey E. (eds.), *Oxford Handbook of International Environmental Law*, Oxford University Press, 2008, pp. 9-10. ←
73. For an analysis of the management of outer space as a commons, see Babcock H. M., “The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET”, in *Syracuse Law Review*, Vol. 69, No. 2, 2019, pp. 191-262. ←
74. Viikari L., “Environmental aspects of space activities”, *op. cit.*, p. 764. ←
75. Ben-David M., *op. cit.*, p. 557. ←
76. French D., “Sustainable development”, in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 52-53. See also Fitzmaurice M. A., *op. cit.*, p. 47-49. ←
77. French D., *ibidem*, p. 53; Prasad M. D., *op. cit.*, p. 168. ←
78. Report of the World Commission on Environment and Development, “Our Common Future”, Oxford, Oxford University Press, 1987, p. 43. ←

79. Barral V., "Sustainable Development in International Law: Nature and Operation of an Evolutive Legal Norm", in *E.J.I.L.*, Vol. 23, No. 2, 2012, p. 380; Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 134-135; Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 115 and ff. ←
80. "In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it" (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 4). ←
81. ICJ, *Gabčíkovo-Nagymaros Project (Hungary/Slovakia)*, Judgment, IJC Reports (1997), para. 40. ←
82. Fitzmaurice M. A., *op. cit.*, p. 47; Barral V., *op. cit.*, p. 381. ←
83. French D., *op. cit.*, p. 59-61. See *Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 3. ←
84. Barral V., *op. cit.*, p. 381. Although it is closely linked to environmental protection as such, the principle of intergenerational equity still retains a very anthropocentric aspect as it mainly focuses on human interests to be preserved (Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 133-134). ←
85. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 133; Barral V., *op. cit.*, p. 381. ←
86. Intragenerational equity has been described by the International Law Association as "the right for all peoples within the current generation of fair access to the current generation's entitlements to the Earth's natural resources" (International Law Association, *New Delhi Declaration of Principles of International Law Relating to Sustainable Development*, 2002, at 2.1.). ←
87. UNCOPUOS considers the implementation of the space debris mitigation guidelines as a "prudent and necessary step towards preserving the outer space environment for future generations" (*Report of the Committee on the Peaceful Uses of Outer Space on its fiftieth session (6-15 June 2007)*, GAOR, Sixty-second session, Supp. No. 20, A/62/20 (2007), Annex IV, p. 1). ←
88. This concern was highlighted in the preamble of the Outer Space Treaty in 1967: "Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development (...)" (Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, p. 205, preamble). ←
89. Guidelines for the long-term sustainability of outer space activities, para 5. ←
90. It has been argued that deliberate degradation of the outer space environment, which may have the consequence that less developed countries would not be able to exercise their right to conduct space activities, would violate the Outer Space Treaty and its requirement of equity and respect of all States' interests. It has also been suggested that the principle of intragenerational equity requires industrialised States to assist less developed countries in developing the means to conduct space activities and protect the environment (Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 145-147). ←
91. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, preamble. ←
92. French D., *op. cit.*, p. 58; Fitzmaurice M. A., *op. cit.*, p. 53-54. ←
93. Fitzmaurice M. A., *op. cit.*, p. 259. ←
94. French D., *op. cit.*, p. 58. ←
95. Principle 8 urges States to "reduce and eliminate unsustainable patterns of production and consumption" (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 8). ←
96. International Law Association, *New Delhi Declaration of Principles of International Law Relating to Sustainable Development*, 2002, at 1.2. ←

97. International Law Association, New Delhi Declaration of Principles of International Law Relating to Sustainable Development, 2002, at 1.3. ←
98. Gupta V., *op. cit.*, p. 31. ←
99. Prasad M. D., *op. cit.*, p. 170. ←
100. Pyhälä M., Brusendorff A. C. and Paulomäki H., "The precautionary principle", in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 205; de Sadeleer N., "The Principles of prevention and precaution in international law: two heads of the same coin?", in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 185. ←
101. "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (*Report of the United Nations Conference on Environment and Development 3-14 June 1992*), A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 15). ←
102. Wiener J. B., "Precaution", in Bodansky D., Brunnee J. and Hey E. (eds.), *Oxford Handbook of International Environmental Law*, Oxford University Press, 2008, pp. 597-612; Pyhälä M., Brusendorff A. C. and Paulomäki H., *op. cit.*, p. 203. ←
103. Fitzmaurice M. A., *op. cit.*, p. 263. ←
104. Pyhälä M., Brusendorff A. C. and Paulomäki H., *op. cit.*, p. 211; Fitzmaurice M. A., *op. cit.*, p. 263-264. ←
105. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 177. ←
106. Given the ultra-hazardous nature of most activities conducted in outer space, it has been suggested that gravity of potential harm and the probability of it happening would have to be put on balance in order to determine the level of precaution required, in the case of near-Earth-objects for instance (see American Institute of Aeronautics and Astronautics, *Responding to the Potential Threat of a Near-Earth-Object Impact*, AIAA Position Paper Prepared by the Space Systems Technical Committee and the Systems Engineering Technical Committee, September 2005). ←
107. Duvic-Paoli L.-A., *The Prevention Principle in International Environmental Law*, New York, Cambridge University Press, 2018, p. 8. ←
108. Duvic-Paoli L.-A., *ibidem*, p. 9-10. The no-harm principle, or *sic utere tuo* principle, dates back to Roman law and implies that States "may not use their territory and the resources under their control in such a way as to cause significant harm to the environment of other states or event to areas beyond any national jurisdiction" (Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 150). As for the good neighbourliness principle, it implies that States conducting activities that affect the global commons and utilising environmental resources, should exercise that right in such a way that other States can utilise those resources equally or receive a reasonable and equitable share of the benefits (Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 152). ←
109. Viikari L., "Environmental aspects of space activities", *op. cit.*, p. 762. ←
110. Duvic-Paoli L.-A., *op. cit.*, p. 10. ←
111. Prasad M. D., *op. cit.*, p. 169 ←
112. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, p. 205, Article IX. ←
113. Guidelines for the long-term sustainability of outer space activities, para 1. ←
114. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 157. ←
115. "States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command." (*Report of the United Nations Conference on Environment and Development 3-14 June 1992*), A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 7). ←

116. Fitzmaurice M. A., *op. cit.*, p. 64; Barral V., *op. cit.*, p. 381. ←
117. Fitzmaurice M. A., *op. cit.*, p. 65. The principle stems from an acknowledgement of the divide between industrialised countries and developing countries, which is a recurrent feature in international environmental law (Cullet P., "Common but differentiated responsibilities", in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 161). ←
118. In that respect, differentiation among States ultimately aims at fostering substantive equality where formal equality would fail to take pervasive inequalities - in terms of contribution to the problem, capacities to tackle it or level of economic development - into account (Cullet P., *op. cit.*, p. 162-166). ←
119. Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 132-134; Barral V., *op. cit.*, p. 382. ←
120. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 182-183. ←
121. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 182-183. ←
122. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 182. ←
123. Schwartz P., "The polluter-pays principle", in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 244. ←
124. Hey E., *op. cit.*, p. 76-77. ←
125. Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 322; Hey E., *ibidem.*, p. 77. ←
126. Birnie P., Boyle A. and Redgwell C., *ibidem.*, p. 322; Hey E., *ibidem.*, p. 77. See Principle 16 of the Rio Declaration, which states that: "National authorities should endeavor to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment" (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 16). ←
127. Viikari L., "Environmental aspects of space activities", *op. cit.*, p. 764. ←
128. Viikari L., "Environmental aspects of space activities", *op. cit.*, p. 764. ←
129. Viikari L., "Environmental aspects of space activities", *op. cit.*, p. 764. ←
130. Convention on Environmental Impact Assessment in a Transboundary Context, opened for signature in Espoo, 25 February 1991, *U.N.T.S.*, Vol. 1989, p. 309, Article 1(vi). ←
131. "Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority" (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 17). ←
132. Elias O., "Environmental impact assessment", in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 227; Prasad M. D., *op. cit.*, p. 168. ←
133. Elias O., *ibidem.*, p. 227; Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 165. ←
134. Elias O., *op. cit.*, p. 228. ←
135. In the United States, the NASA conducts formal assessments of its programs' potential for generating debris and possible mitigation measures (Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 274). ←
136. Inter-Agency Space Debris Coordination Committee, *Space Debris Mitigation Guidelines*, September 2007, section 4. ←
137. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 280-281. ←

138. See *Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 27. ←
139. Hey E., *op. cit.*, p. 55-56. Principle 19 of the Rio Declaration provides that “States shall provide prior and timely notification and relevant information to potentially affected States on activities that may have a significant adverse transboundary environmental effect and shall consult with those States at an early stage and in good faith” (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 19). ←
140. Hey E., *op. cit.*, p. 56. ←
141. “In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance” (Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, p. 205, Article IX). See also Prasad M. D., *op. cit.*, p. 169). ←
142. Guidelines for the long-term sustainability of outer space activities, para 1. ←
143. “States should co-operate to strengthen endogenous capacity-building for sustainable development by improving scientific understanding through exchanges of scientific and technological knowledge, and by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies” (*Report of the United Nations Conference on Environment and Development (3-14 June 1992)*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 9). ←
144. Hey E., *op. cit.*, p. 78. ←
145. Bird R. C., “Procedural Challenges to Environmental Regulation of Space Debris”, in *American Business Law Journal*, Vol. 40, 2003, p. 652. ←
146. Guidelines for the long-term sustainability of outer space activities, guideline C.3. ←
147. See *Report of the United Nations Conference on Environment and Development 3-14 June 1992*, A/CONF.151/26 (Vol. I), 12 August 1992, Annex I: Rio Declaration on Environment and Development, Principle 10. ←
148. International Law Association, New Delhi Declaration of Principles of International Law Relating to Sustainable Development, 2002, at 5 and 6. ←
149. Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 288-289. ←
150. Fitzmaurice M. A., *op. cit.*, p. 53. For more detailed developments, see Razzaque J., “Human rights to a clean environment: procedural rights”, in Fitzmaurice M., Ong D. M. and Merkouris P. (eds.), *Research Handbook on International Environmental Law*, Cheltenham, Edward Elgar Publishing, 2010, p. 284-294. ←
151. Guidelines for the long-term sustainability of outer space activities, guideline C.4. ←
152. In this respect, M. A. Drumbl mentions, amongst others, the no-harm principle, the precautionary principle, the requirement to conduct and environmental impact assessment, the principle of cooperation and the notion of common heritage of humankind (Drumbl M. A., *op. cit.*, p. 17). For a more detailed discussion of customary international law, see Bodansky D., “Customary (and Not So Customary) International Environmental Law”, in *Ind. J. Global Legal Stud.*, Vol. 3, 1995, p. 105-119. ←
153. Drumbl M. A., *op. cit.*, p. 17-18. ←
154. French D., *op. cit.*, p. 56. ←
155. Barral V., *op. cit.*, p. 385 and 390-391. ←
156. Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 126-127. ←
157. Prasad M. D., *op. cit.*, p. 172-173. ←

158. French D., *op. cit.*, p. 56; Barral V., *op. cit.*, p. 389. ←
159. Birnie P., Boyle A. and Redgwell C., *op. cit.*, p. 127. ←
160. Bodansky D., *op. cit.*, p. 119. ←
161. Barral V., *op. cit.*, p. 393-394. ←
162. *Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris: A Report of the International Interdisciplinary Congress on Space Debris*, Scientific and Technical Subcommittee of the COPUOS, Forty-eighth session (7-18 February 2011), A/AC.105/C.1/2011/CRP.14 (2011), p. 37. ←
163. Frey S. and Lemmens S., *op. cit.*, p. 7. ←
164. Report of the Committee on the Peaceful Uses of Outer Space on its fiftieth session (6-15 June 2007), GAOR, Sixty-second session, Supp. No. 20, A/62/20 (2007), Annex IV, p. 1. ←
165. Bird R. C., *op. cit.*, p. 663. See the theory of legitimacy in the international system developed by Professor Thomas Franck, identifying four factors of legitimacy: determinacy, symbolic validation, coherence and adherence (Franck T. M., "Legitimacy in the International System", in *Am. J. Int'l L.*, 1988, Vol. 82, p. 712). ←
166. "Introducing the Clearing-House Mechanism for the Convention on Biological Diversity", available on the website of the Convention on Biological Diversity, last consulted on 25 April 2019 in [<https://www.cbd.int/doc/publications/chm-brochure-en.pdf>]. ←
167. McCormick P. K., *op. cit.*, p. 803-804 and 809; Hildreth S. A. and Arnold A., *op. cit.*, p. 10; Inter-Agency Space Debris Coordination Committee, *Stability of the Future LEO Environment*, study by Liou J.-C., Rossi A., Krag H. et al., IADC-12-08, Rev. 1, January 2013, p. 18. ←
168. *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 7. ←
169. Many solutions are being discussed, such as global technical coordination of space traffic (*Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris: A Report of the International Interdisciplinary Congress on Space Debris*, Scientific and Technical Subcommittee of the UNCOUOS, Forty-eighth session (7-18 February 2011), A/AC.105/C.1/2011/CRP.14 (2011), p. 43), capturing derelict satellite with a net or a robotic arm: the European Space Agency is planning a mission called e.deorbit, to be launched in 2023 (see "In-orbit servicing", last updated on 28 February 2019, on the website of the European Space Agency, last consulted on 3 April 2019 in [http://www.esa.int/Our_Activities/Operations/Space_Safety_Security/Clean_Space/in-orbit_servicing]), using space tugs to retrieve the objects or inflatable balloons to increase their drag (*Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 24-28). ←
170. International Convention on Salvage, opened for signature in London, 28 April 1989, *U.N.T.S.*, Vol. 1953, p. 165. For a more detailed presentation and explanation of the law of salvage in maritime law and its link with environmental matters, see Ekhatov E. O., "Protection of the Environment and the International Salvage Convention, 1989: An Assessment", in *Mizan L. Rev.*, 2016, Vol. 10, p. 73-99. ←
171. International Convention on Salvage, opened for signature in London, 28 April 1989, *U.N.T.S.*, Vol. 1953, p. 165 ('Convention on Salvage'), preamble. ←
172. Ekhatov E. O., *op. cit.*, p. 79. ←
173. Convention on Salvage, articles 12 and 13. ←
174. Convention on Salvage, article 14. For further details, see Ekhatov E. O., *op. cit.*, p. 89-90. ←
175. Listner M., "Legal issues surrounding space debris remediation", in *The Space Review*, August 2012, last consulted on 4 April 2019 in [<http://www.thespacereview.com/article/2130/1>]. ←

176. Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature in Washington, London and Moscow, 27 January 1967, *U.N.T.S.*, Vol. 610, p. 205, Article VIII. ←
177. Su J., *op. cit.*, p. 79-80. ←
178. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 33. See also *Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris: A Report of the International Interdisciplinary Congress on Space Debris*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-eighth session (7-18 February 2011), A/AC.105/C.1/2011/CRP.14 (2011), p. 11. ←
179. Listner M., “Legal issues surrounding space debris remediation”, in *The Space Review*, August 2012, last consulted on 4 April 2019 in [<http://www.thespacereview.com/article/2130/1>]. ←
180. *Report of the Committee on the Peaceful Uses of Outer Space on its sixty-first session (20-29 June 2018)*, GAOR, Seventy-third session, Supp. No. 20, A/73/20 (2018), para. 263. See also Su J., *op. cit.*, p. 79-80; Hildreth S. A. and Arnold A., *op. cit.*, p. 11; Popova R. and Schaus V., *op. cit.*, p. 55. ←
181. General Assembly Resolution 2625(xxv), Declaration on the Principles of International Law Concerning Friendly Relations and Cooperation Among States, A/8018, 24 October 1970, p. 123. ←
182. Presentation by P. Dempsey as part of the session “Discussion and Adoption of Regulatory Principles and Proposals (Declaration) for Space Debris Remediation and On-orbit Servicing” during the International Interdisciplinary Congress on Space Debris Remediation (2011), last consulted on 25 April 2019 in [https://www.mcgill.ca/iasl/files/iasl/sdc2011_5_dempsey.pdf]. ←
183. Li L., *op. cit.*, p. 333. ←
184. *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 28-29. A proper financial mechanism is deemed essential to allow States to discharge their environmental obligations (Fitzmaurice M. A., *op. cit.*, p. 55). ←
185. *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 29. ←
186. Convention on International Liability for Damage Caused by Space Objects, opened for signature in London, Moscow and Washington, 29 March 1972, *U.N.T.S.*, Vol. 962, p. 187, Articles II and III. See Kerrest A. and Thro C., “Liability for damage caused by space activities”, in Jakhu R. S. and Dempsey P. S. (eds.) *Routledge Handbook of Space Law*, New York, Routledge, 2017, p. 65. ←
187. Convention on International Liability for Damage Caused by Space Objects, opened for signature in London, Moscow and Washington, 29 March 1972, *U.N.T.S.*, Vol. 962, p. 187, Article IV. ←
188. Su J., *op. cit.*, p. 80; *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 32. ←
189. *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 32. ←
190. Listner M., “Legal issues surrounding space debris remediation”, in *The Space Review*, August 2012, last consulted on 4 April 2019 in [<http://www.thespacereview.com/article/2130/1>]; Hildreth S. A. and Arnold A., *op. cit.*, p. 12; Murtaza A., Pirzada S. J. H., Xu T., Jianwei L., *op. cit.*, p. 61011. For further information about concerns on the part of the United States of America relating to the availability of data in cases of debris removal operations, see *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space: A Report of the International Interdisciplinary Congress on Space Debris Remediation and On-Orbit Satellite Servicing*, Scientific and Technical Subcommittee of the UNCOPUOS, Forty-ninth session (6-17 February 2012), A/AC.105/C.1/2012/CRP.16 (2012), p. 33-35, and the presentation by Schaefer M., “ITAR Issues Connected with Space Debris Remediation and Refueling Satellites” as part of the session concerning “Legal, Regulatory and Strategic Issues related to Space Debris Remediation and On-Orbit Servicing” during the International Interdisciplinary Congress on Space Debris Remediation (2011), last consulted on 27 April 2019 in [https://www.mcgill.ca/iasl/files/iasl/sdc2011_31_schaefer.pdf]. ←

191. Ekhatov E. O., *op. cit.*, p. 80. ←
192. Report of the Scientific and Technical Subcommittee on its fifty-fifth session (29 January-9 February 2018), UNCOPUOS, Sixty-first session (20-29 June 2018), A/AC.105/1167 (2018), para. 132. ←
193. *Report of the Legal Subcommittee on its fifty-seventh session (9-20 April 2018)*, UNCOPUOS, Sixty-first session (20-29 June 2018), A/AC.105/1177 (2018), para. 160 to 162; Bird R. C., *op. cit.*, p. 665. ←
194. See, for example, Mirmina S. A., "Reducing the Proliferation of Orbital Debris: Alternatives to a Legally Binding Instrument", in *American Journal of International Law*, Vol. 99, 2005, p. 649; Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 208. ←
195. Viikari L., *The Environmental Element in Space Law*, *op. cit.*, p. 204. ←
196. Bohlmann U. M. and Freeland S., *op. cit.*, p. 390. ←
197. See, in this respect, the analysis by Joseph Kurt, who concludes that "[while] some find voluntary cooperation on the issue of space debris counterintuitive, it really is common sense. The actors involved recognize clearly that shortsighted, self-interested actions will lead to a terrible disaster that they could only regret", while specifying that policymakers should still "deliberately cultivate the preconditions that these economists suggest facilitate cooperation" (Kurt J., *op. cit.*, p. 334). ←
198. See the presentation by Johnson-Freese J., "Jumpstarting Space Debris Mitigation/Remediation", as part of the session concerning "Organizational and Operational Requirements" during the International Interdisciplinary Congress on Space Debris Remediation (2011), last consulted on 27 April 2019 in [https://www.mcgill.ca/iasl/files/iasl/sdc2011_4_johnson-freese.pdf]. ←