

Clearing up the Space Junk: On the Flaws and Potential of International Space Law to Tackle the Space Debris Problem

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Space debris – image by Amer Case (cc)

1. Introduction

100 million, 50 million, 23.000... These figures correspond to the number of – respectively – one millimeter space debris,¹ up to one millimeter space debris, and space debris larger than a softball, which were orbiting the Earth in 2021.² Travelling at a speed of 25,266 km/h in the low Earth orbit (LEO), all those pieces of debris – even the tiniest ones – can cause serious material damage to satellites and spacecraft as well as endanger the life of astronauts aboard. Such accidents have already occurred. In 1996, the debris from an Ariane launcher hit and damaged a French

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¹ Space debris is generally construed as being non-functional *man-made* space objects, including fragments and elements thereof, see e.g. Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2010), at 1 (hereafter Space Debris Mitigation Guidelines) available at https://www.unoosa.org/pdf/publications/st_space_49E.pdf (last visited 6 February 2023). This definition is relied on in this ESIL Reflection. Yet, it is worth noting at the outset that *natural* meteoroids also constitute a type of space debris, which is not discussed here. On this distinction, see e.g. NASA, ‘Space Debris and Human Spacecraft’ (26 May 2021) available at https://www.nasa.gov/mission_pages/station/news/orbital_debris.html (last visited 6 February 2023).

² See NASA, ‘Space Debris and Human Spacecraft’, *ibid*.

microsatellite.³ More recently, in 2022, the International Space Station (ISS) had to manoeuvre to avoid the debris of the Russian satellite Cosmos 1408 which was approaching dangerously.⁴ That debris resulted from an anti-satellite weapon test performed by Russia in 2021, a kind of test carried out earlier by the USA, India and China.⁵ Besides debris originating from such tests or from the launching of rockets, debris is also the by-product of random collisions between existing debris and space objects. Given the increasing amount of such space debris and the increasing number of objects in outer space, as illustrated by the Starlink satellites constellation, the frequency of such collisions will no doubt increase in the future and occur *in cascade*, a phenomenon known as the 'Kessler syndrome'.⁶

As a result, the LEO may become a belt impossible for spacecraft to go through without running a high risk of collision with space debris. This would create a fundamental intergenerational inequity by depriving – partly or fully – future generations of the enjoyment of the most fundamental space right: the right to explore and use space freely.⁷ But space debris has already limited the enjoyment of this right as it puts at risk spacecraft, satellites and the astronauts involved in scientific and/or commercial activities. Also, the proliferation of space debris is turning outer space into a dump, which is a crucial environmental concern.

Similar concerns also arise on Earth as a result of the intended or unintended re-entry of space debris. That debris has the potential to cause material and physical damage, a risk which will increase in the future given the rise in space activities undertaken by government agencies and private companies.⁸ Because of this quantitative rise, the danger will get even more acute as it will become more and more

³ See e.g. Mark Ward, 'Satellite Injured in Space Wreck' in *New Scientist* (24 August 1996) available at <https://www.newscientist.com/article/mg15120440-400-satellite-injured-in-space-wreck/> (last visited 6 February 2023).

⁴ See e.g. Tariq Malik, 'International Space Station Dodges Orbital Debris from Russian Anti-Satellite Test' in *Space.com* (19 June 2022) available at <https://www.space.com/space-station-dodges-russian-satellite-debris> (last visited 6 February 2023).

⁵ See e.g. Mark Smith, 'Anti-Satellite Weapons: History, Types and Purpose' in *Space.com* (10 August 2022) available at <https://www.space.com/anti-satellite-weapons-asats> (last visited 6 February 2023). In April 2022, the USA announced a moratorium on destructive, direct-ascent antisatellite weapons tests, see <https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/04/18/remarks-by-vice-president-harris-on-the-ongoing-work-to-establish-norms-in-space/> (last visited 6 February 2023).

⁶ Donald L Kessler and Burton G Cour-Palis, 'Collision Frequency of Artificial Satellites: the Creation of a Debris Belt' (1978) 83 *Journal of Geophysical Research – Space Physics* 2637–2646.

⁷ See notably Article I of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted 27 January 1967, entered into force 10 October 1967) 610 UNTS 205.

⁸ Michael Byers, Ewan Wright, Aaron Boley and Cameron Byers, 'Unnecessary Risks Created by Uncontrolled Rocket Reentries' (2022) 6 *Nature Astronomy* 1093–1097.

difficult to predict where and when space debris falls.⁹ For instance, in 2021, debris from a Chinese Long March 5B rocket struck two villages in the Ivory Coast damaging several buildings.¹⁰ The re-entry of space debris on Earth is also becoming a crucial issue because of the damage caused to the environment *per se*, including the marine environment. Such a concern is well illustrated by 'Point Nemo', also known as the 'spacecraft cemetery'. 260 space objects have been sunk by space agencies in this zone of the Pacific Ocean, for instance the Russian space station MIR, which will likely be joined by the ISS.¹¹

Clearly, it has become of paramount importance to take space debris seriously and to clear up the numerous threats that it causes.

Technology has a key role to play to reach that objective, in particular to remove space debris. It is worth flagging up in this respect the bipartisan bill introduced on 13 September 2022 in the US Congress – the Orbital Sustainability Act – which aims at fostering technological developments.¹² Technology is also crucial to limit the amount of debris generated by space objects, especially by controlling de-orbiting. But, irrespective of the fact that existing technologies are not always used, as illustrated by the uncontrolled re-entry of component parts of the Chinese Long March 5B rockets mentioned above, technology can prove dysfunctional. The SpaceX debris found in the Snowy Mountain region in Australia in 2022 evidences this risk.¹³

Alongside technology, law and public international law in particular have an important role to play to prevent accidents and to ensure reparation when they occur. Unfortunately, as with many space

⁹ Fabian Zander, 'Space Debris is Coming Down More Frequently. What are the Chances it Could Hit Someone or Damage Property?' *The Conversation* (3 August 2022) available at <https://theconversation.com/space-debris-is-coming-down-more-frequently-what-are-the-chances-it-could-hit-someone-or-damage-property-188062> (last visited 6 February 2023).

¹⁰ See e.g. Edward Helmore, 'Chinese Rocket's Chaotic Fall to Earth Highlights Problem of Space Junk' *The Guardian* (8 May 2021) available at <https://www.theguardian.com/science/2021/may/08/chinese-rocket-space-junk-long-march-5gb> (last visited 6 February 2023).

¹¹ See e.g. Vito De Lucia, 'Splashing Down the International Space Station in the Pacific Ocean: Safe Disposal or Trashing the Ocean Commons' *EJIL:Talk!* (23 February 2022) available at <https://www.ejiltalk.org/splashing-down-the-international-space-station-in-the-pacific-ocean-safe-disposal-or-trashing-the-ocean-commons/> (last visited 6 February 2023).

¹² U.S. Senate Committee on Commerce, Science & Transportation, Press Release (13 September 2022) available at <https://www.commerce.senate.gov/2022/9/cantwell-hickenlooper-lummis-wicker-introduce-bill-to-thin-out-the-900-000-pieces-of-orbiting-junk-that-endanger-the-future-of-> at <https://www.bbc.com/news/world-australia-62414438space-exploration> (last visited 6 February 2023).

¹³ See e.g. Elsa Maishman, 'Space Debris Australia: Piece of SpaceX capsule crashes to Earth in field' *BBC News* (3 August 2022) available at <https://www.bbc.com/news/world-australia-62414438> (last visited 6 February 2023).

issues today, public international law does not appear to be really fit for purpose. Indeed, there is no tailor-made binding instrument or rule which addresses space debris specifically. More generally, the international space treaties currently in force were concluded decades ago, at a time when space debris was not at the forefront of the policy agenda. Consequently, the application of those treaties to space debris raises numerous interpretative questions. But more fundamentally, they simply do not address a number of issues raised by space debris. This holds true notably for the protection of the environment *per se*. Indeed, the object and purpose of those treaties are largely human-oriented, the protection of the space and Earth environments therein being largely instrumental. They aim first and foremost at ensuring that space activities can be conducted safely, the ultimate goal being to guarantee freedom in the exploration and use of outer space.

Against that backdrop, this ESIL Reflection aims at appraising the flaws and potential of international space law to clear up the space junk, i.e. to make outer space a cleaner place and, more generally, to solve the space debris problem. For that purpose, it focuses on the most relevant provisions of the Outer Space Treaty (section 2) and of the Liability Convention (section 3).¹⁴

2. The Outer Space Treaty

Preliminary remarks

Besides Article I, which sets out the governing principles and objectives of the Outer Space Treaty, Article IX is the key provision to be relied on as regards space debris. It provides:

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 cooperation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose.

¹⁴ Convention on International Liability for Damage Caused by Space Objects (adopted 29 March 1972, entered into force 1 September 1972) 861 UNTS 187.

As a preliminary matter, it is worth emphasising a fundamental flaw in this provision regarding the Earth environment: it addresses only adverse changes resulting from the introduction of *extraterrestrial* matter. Being man-made,¹⁵ space debris cannot be considered as such matter. This entails that States Parties, when conducting exploration and using¹⁶ outer space, have no obligation under Article IX to avoid adverse changes caused by space debris to the Earth environment. By the same token, they have no obligation to adopt appropriate measures to avoid such changes.

Turning to the potential of this provision to clear up the space junk, two main normative tools can be singled out: the ‘no harm’ rule (2.2) and the ‘due regard’ obligation (2.1). In both cases, it is worth noting at the outset that States Parties shall bear international responsibility for the national activities carried on by non-governmental entities and for assuring that their activities are carried out in conformity with Article IX. This derives from the general obligation that States Parties have under Article VI of the Outer Space Treaty to assure that national activities are carried out in conformity with the provisions of the Treaty. This is to be linked to the obligation that Article VI also places upon States Parties to continuously supervise – and also authorise – the outer space activities of non-governmental entities. All these obligations are crucial given the increasing role played by the private industry in the exploration and use of outer space, and given its corresponding contribution to the space junk.

2.1 The ‘due regard’ obligation

In accordance with Article IX of the Outer Space Treaty quoted above, States Parties are under the obligation to conduct all their activities in outer space with due regard to the corresponding interests of all other States Parties. As evidenced by the law of the sea, where the ‘due regard’ obligation plays an important role,¹⁷ this obligation – which is of conduct – aims at ensuring a balance between concurrent rights.¹⁸

In this respect, it is useful to refer to the views expressed by the arbitral tribunal in the *Chagos Marine Protected Area* case about the elements to be taken into account in this balancing and about the substance of the ‘due regard’ obligation more generally. The tribunal stated that this obligation does

¹⁵ See fn 1.

¹⁶ As for the relevance of the *use* of outer space in the second sentence of Article IX, see below Section 2.2.

¹⁷ See e.g. Julia Gaunce, ‘On the Interpretation of the General Duty of “Due Regard”’ (2018) 32 *Ocean Yearbook* 27–59.

¹⁸ Mathias Forteau, ‘The Legal Nature and Content of Due Regard Obligations in Recent International Case Law’ (2019) 34 *The International Journal of Marine and Coastal Law* 25–42, 28.

not set any universal rule of conduct. It also stressed that the extent of the regard required depends upon the nature of the rights, their importance, the extent of the anticipated impairment, the nature of the activities contemplated, and also upon the availability of alternative approaches.¹⁹ The tribunal insisted that the degree of the regard which is required is proportional to the significance of the rights involved.²⁰

As for the latter point, it is worth repeating that space debris hampers the exercise of the most fundamental right in international space law: the freedom to use and to explore outer space. This calls for a high degree of regard by States Parties. More generally, and although the law of the sea teaches us that the regard due typically materialises into a *procedural* obligation,²¹ Article IX of the Outer Space Treaty has been interpreted as conferring a substantive dimension to this obligation. Such an interpretation is based on the connection between the ‘due regard’ obligation and the ‘no harm’ rule, also provided in that Article.²²

2.2 The ‘no harm’ rule

Article IX of the Outer Space Treaty places upon States Parties the obligation to conduct exploration of outer space so as to avoid its harmful contamination and, where necessary, to adopt appropriate measures. This ‘no harm’ rule can be linked to and interpreted in the light of the prohibition under customary international law to cause transboundary environmental harm.²³

¹⁹ Interpreting Article 56.2 (Rights, jurisdiction and duties of the coastal State in the exclusive economic zone) of the United Nations Convention on the Law of the Sea (UNCLOS) (adopted 10 December 1982, entered into force 16 November 1994) 1833 UNTS 397. *Chagos Marine Protected Area Arbitration (Republic of Mauritius v the United Kingdom of Great Britain and Northern Ireland)* Award (18 March 2015) available at <https://www.pcacases.com/pcadocs/MU-UK%2020150318%20Award.pdf> (last visited 6 February 2023), para 519.

²⁰ *ibid*, para 521.

²¹ See e.g. Alexander Proelß (ed), *The United Nations Convention on the Law of the Sea. A Commentary* (Oxford: Hart Publishing 2017), at 431. The procedural dimension of the ‘due regard’ obligation translates into a duty to consult and cooperate. In this respect, the ‘due regard’ obligation in Article IX of the Outer space treaty can be linked to the obligation for States Parties under that Treaty to be guided by the principle of cooperation and mutual assistance in the exploration and use of outer space.

²² Peter Stubbe, *State Accountability for Space Debris – A Legal Study of Responsibility for Polluting the Space Environment and Liability for Damage Caused by Space Debris* (Leiden: Brill 2018), at 154.

²³ While it was first set out in non-binding instruments – the Stockholm declaration and the Rio Declaration –, this principle is no doubt nowadays part of customary international law. This was recognized by the International Court of Justice (ICJ) in the *Advisory Opinion on the legality of the threat or use of nuclear weapons*. Interestingly for the purpose of space debris, the Court made it clear in this Opinion that States shall ensure that activities within their jurisdiction and control, not only respect the environment of other States, but also areas beyond national control. Outer space can be seen as precisely such an area beyond national control. As a result, this customary rule is arguably applicable to outer space or constitute, under Article 31 (3) (c) of the Vienna Convention on the Law of Treaties, a relevant rule of international law to be taken into account to interpret the Outer Space Treaty.

Read in relation to space debris, this rule raises many interpretative issues. Notably, Article IX refers to ‘the exploration’ of outer space, but not to its ‘use’, which is highly relevant as regards space debris. Also, the question arises as to whether space debris is to be considered as a ‘contamination’ for the purpose of this Article. And if it is, what are those ‘harmful’ contaminations that it may cause, and what are those ‘appropriate measures’ which shall be adopted to avoid them?²⁴ There are literal and contextual arguments to support the view that the ‘no harm’ rule covers not only the exploration of outer space, but also its use.²⁵ Likewise, there are arguments against limiting ‘contamination’ to biological or chemical contaminations and, to the contrary, in favour of extending it to space debris.²⁶ Yet, it remains to be determined what the threshold of ‘harmful’ contamination is and what ‘appropriate measures’ consist of in relation to space debris. The answer to both questions is no doubt case-specific. That being said, from a systemic point of view, one may suggest that the degree of pollution of the orbit concerned plays an important role in the characterisation of a contamination as being harmful, or not. As for the LEO which is the area with most space debris, this means that the threshold would be significantly lower compared to the threshold applicable to other Earth orbits. To appraise the appropriateness of the measures to be adopted, existing non-binding technical guidelines, notably the UNCOPUOS Space Debris Mitigation guidelines, are of great use and interest. Indeed, those guidelines provide indications about limiting the debris released, minimizing break-ups of space objects, limiting the risk of accidental collisions in orbit, and also about avoiding intentional destruction or other harmful activities.²⁷

3. The Liability Convention

The Liability Convention specifies the guiding principle set out in Article VII of the Outer Space Treaty. This Article provides:

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State

²⁴ See e.g. Sophie Kaineg, ‘The Growing Problem of Space Debris’ (2019) 26 *Hastings Environmental Law Journal* 277–288, 283.

²⁵ See e.g. Stubbe, fn 22, at 154.

²⁶ See e.g. Allen L Springer, ‘Towards a Meaningful Concept of Pollution in International Law’ (1977) 26 *International and Comparative Law Quarterly* 531–557.

²⁷ See respectively, Guidelines 1, 2, 3 and 4, Space Debris Mitigation Guidelines, fn 1.

Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.

In implementing the liability principle enshrined in Article VII, the Liability Convention distinguishes between two situations, depending on where the damage caused by space objects occurs: on the surface of the Earth (Article II) and elsewhere than on the surface of the Earth (Article III). Before discussing the regimes of liability the Convention sets out for both situations (3.2), it is first warranted to focus on specific aspects of its scope of application which prove of particular relevance when considering space debris (3.1).

3.1 Scope of application

Two main issues are worth flagging up here: Does the Convention actually apply to ‘space debris’ (3.1.1)? And, what is a ‘launching State’ (3.1.2)?

3.1.1 Space objects

To answer the first question, one must focus on the meaning of ‘space object’ and determine whether ‘space debris’ falls into that category. The Liability Convention refers to ‘space object’ in Article I as including component parts of a space object as well as its launch vehicle and parts thereof. On the other hand, it does not provide – nor does any space treaty – any definition of ‘space debris’. Non-binding international instruments do provide for such a definition. Notably, the UNCOPUOS Space Debris Mitigation guidelines define space debris as follows: ‘All man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional’.²⁸

Different views have been expressed as to whether space debris qualifies as space objects under the Liability Convention. Some authors adopt a very restrictive approach, notably on the basis that space debris was not an issue that States intended to tackle at the time of the conclusion of the Convention. As a result, they interpret ‘space object’ as covering only satellites and their component parts, ‘component part’ being construed as being less comprehensive than ‘part’, a term which is seen as covering pieces.²⁹ There is much to be discussed in that regard; from a literal point of view, it is worth noting in any case that the definition provided in Article I is not an exhaustive one.³⁰ This leaves room

²⁸ See fn 1, at 1.

²⁹ See e.g. Nicolas M Matte, ‘Environmental Implications and Responsibilities in the Use of Outer Space’ (1989) 14 *Annals of Air and Space Law* 419–447, 435, referred to in Stubbe, fn 22, at 388.

³⁰ Article I uses the term ‘includes’ indeed.

for arguing that space debris is to be considered as space objects for the purpose of the Liability Convention and, therefore, for extending its application to damage caused by this debris.

3.1.2 Launching states

As can be inferred from Article VII of the Outer Space Treaty and as is made clear in Article I of the Liability Convention, the launching State is to be understood as: 1) the State which launches, 2) the State which procures the launching, 3) the State from whose territory a space object is launched, and 4) the State from whose facility a space object is launched. Two remarks can be formulated about this definition.

First, for the same launching from which space debris originates, several States can be characterised as a launching State, based on different grounds. This means that all these States are to be considered as potentially liable as regards such a 'joint launching', which leads to a situation of joint and several liability as provided in Article V of the Liability Convention.³¹ This no doubt constitutes strong security for the State affected. Indeed, that State may require only one of those launching States to pay the full amount of compensation. In such a case, that launching State then has the right to present a claim for indemnification to the other launching States.

Second, there is the issue of the involvement of private companies in the launching, with regard to the launching as such, its procurement or the provision of the launching facility. Does their conduct entail State liability? This issue is not addressed specifically in the Liability Convention. However, it is to be contemplated in light of Article VI of the Outer Space Treaty. As discussed in Section 2's Preliminary remarks, this Article provides that States Parties shall bear international responsibility for national activities in outer space carried on by non-governmental entities.

3.2 Regimes of liability

The Liability Convention provides for two different regimes of liability depending on where damage occurs.

Article II addresses those situations where damage is caused by a space object on the surface of the Earth or to an aircraft in flight. For such damage, it sets a principle of absolute liability, conferring

³¹ On this issue, see e.g. Pablo Mendes de Leon and Hanneke van Traa, 'Space Law' in André Nollkaemper and Ilias Plakokefalos (eds), *The Practice of Shared Responsibility in International Law* (Cambridge: Cambridge University Press 2017) 453–478.

thereby a high level of protection to the State affected.³² Such a regime is all the more needed as the risk mainly concerns a limited number of States all located near the Equator. This is due to the fact that the risk of re-entry onto Earth is higher for those States as launches typically take place in that region.³³ Irrespective of the damage suffered by States or their population, it is worth noting that the protection of the environment *per se* is not addressed by Article II. This is confirmed by Article I which does not refer to damage caused to the environment, the term 'damage' being construed in that provision as encompassing the loss of life, personal injury or other impairment of health, the loss of or damage to the property of States or of natural or juridical persons, or the property of international intergovernmental organisations.

For those situations where damage is caused by a space object 'elsewhere than on the surface of the earth', i.e. in outer space, Article III of the Liability Convention sets out another regime of liability. They are governed by the principle of fault liability.

Those two regimes of liability raise many issues in relation to space debris, some being common to both, others specific to each.

Among the common issues, there is the link to be evidenced between the space debris causing damage and a launching State. Registration and space surveillance information can help in evidencing this link. It remains that doing so can prove to be a difficult exercise in practice, the difficulty varying of course depending on the type of space debris involved. In relation to this issue, it is worth emphasising the exclusion contained in Article VII of the Liability Convention. It provides that the Convention – including Articles II and III – does not apply to damage caused by a space object of a launching State to the nationals of that launching State. Two remarks are warranted here. Because the entities – including the non-governmental entities – which own satellites often have the nationality of those few States active in launching activities, it is likely that some of the accidents which will occur in the future will involve only one nationality, thereby depriving those entities of any right to

³² This provision constituted one of the bases of the claim made by Canada following the Cosmos 954 incident, when a USSR satellite re-entered Earth over Canada in 1978 causing the spread of space debris over an area of 124,000 square miles. This incident led to the conclusion of an Agreement between the two countries in 1981. Agreement available at https://www.unoosa.org/oosa/en/ourwork/spacelaw/nationalspacelaw/bi-multi-lateral-agreements/can_ussr_001.html (last visited 6 February 2023). See also Joseph A Burke, 'Convention on International Liability for Damage Caused by Space Objects: Definition and Determination of Damages After the Cosmos Incident' (1984) 8 *Fordham International Law Journal* 255–285.

³³ See, Byers, Wright, Boley and Byers, fn 8. As stated in that study, the risk of re-entry of a rocket or part thereof is at least three times higher in the latitudes of Jakarta, Dhaka, Mexico City, Bogota and Lagos as it is in those of Washington DC, New York, Beijing and Moscow.

compensation. Yet, when considering joint launchings, it is worth noting that this deprivation does not operate in relation to the other launching States, which then may be required to pay compensation.³⁴

Concerning fault liability for damage caused in outer space specifically, a fundamental issue is the standard of liability to be applied. 'Fault' is not defined in the Liability Convention.³⁵ However, both public international law and comparative law lead us to construe it as intentional or negligent conduct. The assessment of whether or not a fault was committed is obviously case-specific. That being said, the characterisation of conduct as negligent begs the question of the applicable yardstick to appraise negligence. In the silence of the Convention, such a yardstick is typically to be found in the non-binding space debris technical guidelines mentioned in Section 2.2. In each case, the extent to which the State Party involved in the accident made its best efforts in relation to the best practices recommended therein would then need to be determined.

4. Conclusion

As shown in this ESIL Reflection, international space law displays both flaws and potential to make outer space a cleaner place and, more generally, to solve the space debris problem. No doubt, as with many (legal) issues in outer space, achieving those objectives would fundamentally require the adoption of tailor-made rules and, beyond that, to rethink a regime which was designed at a time when society and technology were very different. In any case, it is also necessary to think outside 'the space law box' and make use of other international law regimes, notably the law of the sea and environmental law, in order to clear up the space junk and, more broadly, to better regulate human activities in outer space.

³⁴ On this matter, see e.g. Bruce A Hurwitz, *State Liability for Outer Space Activities in Accordance with the 1972 Convention on International Liability of Damage Caused by Space Objects* (Dordrecht: Kluwer 1992), at 44 and 45.

³⁵ On the interpretation of 'fault', see e.g. Joel A Dennerley, 'State Liability for Space Object Collisions: The Proper Interpretation of 'Fault' for the Purposes of International Space Law' (2018) 29 *European Journal of International Law* 281–301.

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