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The regulation of space activities and the space environment

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The international legal regulation of outer space has evolved in response to the rapidly expanding activities involving the exploration and use of outer space, beginning at the height of the cold war era. Space law is now an important part of public international law, incorporating significant developments in both space technology and international environmental law. This chapter considers the legal instruments and soft-law principles governing the outer space environment and space activities and explores whether the international law in this area is equipped to deal with the considerable challenges that lie ahead.

Introduction

On 4 October 1957, a Soviet space object, *Sputnik I*, was launched and subsequently orbited the Earth over 1,400 times during the following three-month period. Thus began humankind's adventures in outer space. This milestone heralded the dawn of the space age which, over the ensuing decades, has given rise to the gradual development of fundamental principles that would underpin the legal regulation of the exploration and use of outer space.

The journey of *Sputnik I* highlighted almost immediately some difficult and controversial legal questions, involving previously undetermined concepts. While there had been some (largely) academic scholarship prior to *Sputnik I* regarding the nature and scope of those laws that might be relevant and appropriate in relation to the exploration and use of outer space, these had generally been discussed only at a hypothetical level.[1] However, history changed forever on that day in 1957. All of a sudden, the reality of humankind's aspirations and capabilities with respect to outer space had become apparent, and the world had to react – quickly – to an unprecedented event in an unregulated legal environment, particularly because it was clear that this was just the beginning of what would become an ever increasing

1 For a summary of the main academic theories relating to 'space law' in the period prior to the launch of *Sputnik I*, see e.g. F. Lyall and P.B. Larsen, *Space Law: A Treatise*, London: Ashgate, 2009, pp. 3–9.

quest to undertake a wide range of space activities. First and foremost, this necessitated a clarification as to the legal categorisation of outer space for the purposes of international law.[2]

Although the Soviet Union had not sought the permission of any other state to undertake the *Sputnik* mission, there were no significant international protests asserting that this artificial satellite had infringed any country's sovereignty as it circled the Earth. The almost total international (in)action that stemmed from the *Sputnik* mission confirmed that this new frontier for human activity – outer space – did not, from a legal perspective, possess the traditional elements of sovereignty that had already been well established under the binding international law principles that regulated land, sea and air space on Earth. Instead, it was assumed that outer space was to be regarded as an area beyond territorial sovereignty.

Describing the early emergence of this customary international principle in the context of outer space, Judge Manfred Lachs of the International Court of Justice (ICJ) observed in 1969, shortly after the first of the United Nations Space Law Treaties had been finalised, that:

> [t]he first instruments that men sent into outer space traversed the air space of States and circled above them in outer space, yet the launching States sought no permission, nor did the other States protest. This is how the freedom of movement into outer space, and in it, came to be established and recognised as law within a remarkably short period of time.[3]

As such, virtually immediately after humankind had begun its quest to explore and use outer space, a number of foundational principles of the international law of outer space were born – in particular the so-called 'common interest', 'freedom' and 'non-appropriation' principles. These principles were later incorporated into the terms of the United Nations Space Law Treaties,[4] with the result that they also constitute binding conventional rules, codifying what had already amounted to principles of customary international law. In essence, the community of states, including both of the major space-faring states of the time, had accepted that outer space was to be regarded as being similar to a *res communis omnium*.[5]

These fundamental rules underpinning the international law of outer space represent a significant departure from the legal rules relating to air space, which from a legal perspective is categorised as constituting part of the 'territory' of the underlying state. The territorial nature of air space is reflected in the principal air law treaties. For example, reaffirming the principle that had already been acknowledged as early as 1919,[6] the 1944 Convention on International Civil Aviation[7] provides that:

2 For an overview of these and the ensuing developments, see e.g. S. Hobe, 'Historical Background', in S. Hobe, B. Schmidt-Tedd and K-U. Schrogl (eds) *Cologne Commentary on Space Law, Volume I – Outer Space Treaty*, Cologne: Carl Heymanns Verlag, 2009, pp. 4–11, with further references.

3 *North Sea Continental Shelf Cases (Federal Republic of Germany v Denmark and Federal Republic of Germany v The Netherlands)* (Judgment), Dissenting Opinion of Judge Lachs [1969] ICJ Rep 3, 230.

4 See e.g. *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 27 January 1967, 610 UNTS 205 (entered into force 10 October 1967) ('Outer Space Treaty') Arts I, II.

5 A. Cassese, *International Law*, 2nd edition, Oxford: Oxford University Press, 2005, p. 95.

6 See *Convention on the Regulation of Aerial Navigation*, opened for signature 13 October 1919, 11 LNTS 173 ('Paris Convention').

7 *Convention on International Civil Aviation*, opened for signature 7 December 1944, 15 UNTS 295 (entered into force 4 April 1947) ('Chicago Convention').

> [E]very State has complete and exclusive sovereignty over the air space above its territory.[8]

The ICJ has concluded that this characteristic of air space also represents customary international law.[9] As a consequence, civil and commercial aircraft only have certain limited rights to enter the air space of another state,[10] in contrast to the freedom principle relating to outer space.[11]

Thus, even though it would no doubt be relevant in certain respects – indeed, the Outer Space Treaty affirms that activities in space are to be carried on 'in accordance with international law'[12] – the fact that most existing international law at the time had been developed for 'terrestrial' purposes meant that it was not readily or directly applicable in every respect to this new paradigm of human endeavour. Moreover, the non-sovereignty aspect of outer space meant that any then existent national law (which, in any event, did not at that time specifically address space-related issues) would not *prima facie* apply to this frontier, and would not be the appropriate legal basis upon which to establish the initial framework for regulating the conduct of humankind's activities in outer space. It was clear, therefore, that, at the dawn of the development of 'space law', specific international binding rules would be required to address the particular characteristics and legal categorisation of outer space.

In this context, this chapter first sets out the fundamental principles governing the exploration and use of outer space and then proceeds to discuss in more detail the general regulations that apply to the space environment, focusing on specific areas of more pressing concern. On this basis, this chapter concludes that the existing body of international space law does not provide a comprehensive legal framework for the protection of the environment of outer space, nor rigorous environmental standards in relation to the conduct of space activities. It will therefore be necessary to address these concerns in greater detail in order that humankind will be able to expand its endeavours in space.

An overview of the international law of outer space

The negotiations directed towards formalising into conventional form the relevant binding principles relating to the exploration and use of outer space took some time. This was due to a number of reasons, including the unique environment with which it would have to deal, the very significant political and strategic factors at play and the rapid growth of space-related

8 Chicago Convention, Art. 1. For the purposes of the Chicago Convention, the territory of a State is regarded as 'the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State': Chicago Convention, Art. 2.

9 In *Case Concerning Military and Paramilitary Activities in and against Nicaragua (Nicaragua v United States)* (Merits) (Judgment), the court noted that '[t]he principle of respect for territorial sovereignty is also directly infringed by the unauthorized overflight of a State's territory by aircraft belonging to or under the control of the government of another State': [1986] ICJ Rep 14, 128.

10 See Chicago Convention, Arts 5, 6.

11 Of course, any space activities requiring a launch from Earth and/or a return to Earth will also involve a 'use' of air space. In this respect, the law of air space may be relevant to the legal position if, for example, the space object of one state travels through the air space of another state. See also Art. II of the *Convention on International Liability for Damage Caused by Space Objects*, opened for signature 29 March 1972, (entered into force 1 September 1972) which applies *inter alia* to 'aircraft in flight' (i.e. in air space).

12 Outer Space Treaty, Art. III.

technology that followed almost immediately from the *Sputnik* success. Despite the delays, and at times lengthy and fractious negotiations, the law of outer space has developed as an increasingly important discrete corpus of law within the broader realm of general public international law.

This process of evolution has seen the emergence of new rules, and the codification of existing fundamental international legal principles, all of which regulate the exploration and use of outer space. In general terms, these principles have served to allow for the significant improvement of the standard of living for the whole of humanity through the use of space technology – for example, scientific questions concerning environmental protection and climate change issues of the Earth are addressed by fleets of Earth observation satellites; satellite data facilitates relief efforts in regions that suffer natural or technological disaster. The prospects for the future use of outer space offer both tremendous opportunities and challenges for humankind, and law at both the international level, and also now increasingly at the national level, will continue to be at the forefront in this regard.

There is now a substantial body of international and domestic law dealing with many – although not all – aspects of the exploration and use of outer space. These principles are primarily to be found in a number of United Nations sponsored multilateral treaties, United Nations General Assembly Resolutions, a wide range of national legislation, bilateral arrangements and determinations by intergovernmental organisations.

There are five main multilateral treaties that have been finalised through the auspices of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), the principal multilateral body involved in the development of international space law.[13] These are:

(i) 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies;[14]
(ii) 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space;[15]
(iii) 1972 Convention on International Liability for Damage Caused by Space Objects;[16]
(iv) 1975 Convention on Registration of Objects Launched into Outer Space;[17] and
(v) 1979 Agreement Governing the Activities of States on the Moon and other Celestial Bodies.[18]

These five treaties deal with various important issues relating to outer space. When assessing them, it is important to also bear in mind that these treaties were formulated in the 'cold war' era, when only a relatively small number of countries had space-faring capability, a situation that has changed over time. In general terms, the international legal principles they contain

13 UNCOPUOS was established by the United Nations General Assembly in 1959, shortly after the launch of *Sputnik I*: see *United Nations Committee on the Peaceful Uses of Outer Space* (1959), GA Res 1472(XIV), UN GAOR. It currently has 70 Members, which, according to UNCOPUOS, means that it is 'one of the largest Committees in the United Nations'. Online. Available HTTP: <http://www.unoosa.org/oosa/en/COPUOS/members.html> (accessed 11 August 2011).
14 610 UNTS 205 ('Outer Space Treaty').
15 672 UNTS 119 ('Rescue Agreement').
16 961 UNTS 187 ('Liability Convention').
17 1023 UNTS 15 ('Registration Agreement').
18 1363 UNTS 3 ('Moon Agreement').

provide for the non-appropriation of outer space by any one state, the freedom of the use and exploration of outer space, a liability regime applicable in the case of damage caused by space objects, the safety and rescue of space objects and astronauts, the notification to, and registration of space activities with the United Nations, the scientific investigation and exploitation of the natural resources of outer space, and the settlement of disputes arising from outer space activities.

There are, in addition, five main sets of principles adopted by the United Nations General Assembly (UNGA), each of which relates to specific aspects of the use of outer space. These are:

(i) 1963 Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space;[19]
(ii) 1982 Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting;[20]
(iii) 1986 Principles Relating to Remote Sensing of the Earth from Outer Space;[21]
(iv) 1992 Principles Relevant to the Use of Nuclear Power Sources in Outer Space;[22] and
(v) 1996 Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries.[23]

These sets of principles provide for the application of international law and the promotion of international cooperation and understanding in space activities, the dissemination and exchange of information through transnational direct television broadcasting via satellites and remote satellite observations of the Earth, and general standards regulating the safe use of nuclear power sources necessary for the exploration and use of outer space.

It is generally agreed that Resolutions of the General Assembly are non-binding,[24] at least within the traditional analysis of the 'sources' of international law[25] specified in Article 38(1)

19 *Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space* (1962), GA Res 1962(XVIII), UN GAOR.
20 *Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting* (1982), GA Res 37/92, UN GAOR, 37th Sess, 100th Plen Mtg, UN Doc A/RES/37/92.
21 *Principles Relating to Remote Sensing of the Earth from Outer Space* (1986), GA Res 41/65, UN GAOR, 41st Sess, 95th Plen Mtg, UN Doc A/RES/41/65.
22 *Principles Relevant to the Use of Nuclear Power Sources in Outer Space* (1992), GA Res 47/68, UN GAOR, 47th Sess, 85th Plen Mtg, UN Doc A/RES/47/68 ('Nuclear Power Source Principles').
23 *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries* (1996), GA Res 51/122, UN GAOR, 51st Sess, 83rd Plen Mtg, UN Doc A/RES/51/122.
24 See, e.g., D.J. Harris, *Cases and Materials on International Law*, 6th edition, Andover: Sweet and Maxwell, 2004, pp. 57–61 and the references therein.
25 A growing body of contemporary academic literature that questions the traditional understanding of what constitutes a rule of customary international law has more recently emerged: see e.g. I. Scobbie, 'The Approach to Customary International Law in the Study', in E. Wilmshurst and S. Breau (eds) *Perspectives on the ICRC Study on Customary International Humanitarian Law*, Cambridge: Cambridge University Press, 2007, p. 15. That author (at 24) describes various 'revisionist accounts of custom formation'; see also C. Ochoa, 'The Individual and Customary International Law Formation', *Virginia Journal of International Law* 48, 2007, 119, pp. 135–42.

of the Statute of the International Court of Justice.[26] In the context of the regulation of the use and exploration of outer space, these five sets of principles have largely been considered as constituting 'soft law',[27] although a number of specific provisions may now represent customary international law.[28]

Legal regulation of the space environment – general principles

It is an unfortunate reality that virtually all aspects of the exploration and use of outer space involve elements that are inherently damaging to the space environment – and to the environment of the Earth. Over time, and with the exponential growth of space activities, this has given rise to many (potential) environmental problems relating to space activities, as well as the question of whether, and how, such concerns can and should be addressed within the corpus of the international legal regulation of outer space. Despite the development of those fundamental legal principles referred to above, and the conclusion of the United Nations Space Treaties, it is apparent even from a cursory reading of the basic instruments that the existing body of international space law does not provide a comprehensive legal framework for the protection of the environment of outer space; nor does it specify rigorous environmental standards in relation to the conduct of space activities as they may affect the Earth.

Having said this, it is relevant to note that the United Nations Space Treaties were largely concluded before what has been regarded as the 'environmental movement' relating to activities on Earth had even begun to establish itself, let alone before the development of the significant international environmental law instruments. Even then, the idea that the environment of *outer space* required rigorous regulation was beyond serious consideration, this despite the fact that the need to protect natural celestial environments was at least publically expressed (if not translated into rigorous legal regulation) as being 'among the earliest policies articulated at the dawn of the space age'.[29]

26 1 UNTS 16 (ICJ Statute). It is generally asserted by international law scholars that Article 38(1) of the ICJ Statute lists the so-called 'sources' of international law: see e.g. G. Schwarzenberger, *International Law*, 3rd edition, Volume I, London: Stevens and Sons, 1957, pp. 21–2; Cassese, op. cit., p. 156. Art. 38(1) of the ICJ Statute provides as follows:

> The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:
>
> a. international conventions, whether general or particular, establishing rules expressly recognized by the contesting states;
> b. international custom, as evidence of a general practice accepted as law;
> c. the general principles of law recognized by civilized nations;
> d. subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary means for the determination of rules of law.

27 For a discussion on the use of 'soft-law' instruments in relation to the use and exploration of outer space, see S. Freeland, 'For Better or for Worse? The Use of "Soft Law" within the International Legal Regulation of Outer Space', *Annals of Air and Space Law* 36, 2011.

28 See e.g. R.J. Lee and S. Freeland, 'The Crystallisation of General Assembly Space Declarations into Customary International Law', *Proceedings of the Colloquium on the Law of Outer Space* 46, 2004, 122.

29 L.I. Tennen, 'Evolution of the Planetary Protection Policy: Conflict of Science and Jurisprudence?' *Advances in Space Research* 24, 2004, 2354, p. 2354.

Indeed, the 1972 Stockholm Declaration[30] is generally regarded as the first significant statement of fundamental international principles relating to the protection of the environment.[31] Yet, by the time that the Stockholm Declaration was concluded, the most important fundamental principles relating to the exploration and use of outer space had already been agreed and codified in the Outer Space Treaty and the Liability Convention respectively. Those instruments provided little substance in terms of the protection of the environment, because there was no great concern about the environment of space at the time – why should there have been? – and certainly no appetite to be bound by rigorous environmental protection obligations that might be perceived as impeding the development of the many space activities that were emerging at the time.

However, a number of areas have been considered in the principal space instruments: in terms of the United Nations Space Treaties. The focus has been directed primarily towards the issue of back and forward contamination,[32] and environmental concerns associated with the exploitation of the natural resources of the Moon and other celestial bodies.[33] In addition, there have been a number of soft-law instruments directed *inter alia* towards the use of nuclear power sources in outer space[34] and, in more recent times, of space debris.[35]

Even though these instruments do not directly give rise to internationally binding commitments, they may provide guidance in the assessment of international benchmarks to be considered and applied. In its Advisory Opinion on the *Legality of the Threat or Use of Nuclear Weapons*, the International Court of Justice affirmed:

> the existence of the general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond

30 *Declaration of the United Nations Conference on the Human Environment* (1972), UN Doc A/CONF.48/14/Rev.1 ('1972 Stockholm Declaration').

31 R.J. Parsons, 'The Fight to Save the Planet: US Armed Forces, "Greenkeeping", and Enforcement of the Law Pertaining to Environmental Protection During Armed Conflict', *Georgetown International Environmental Law Review* 10, 1998, 441, p. 455.

32 See Outer Space Treaty, Art. IX, which includes the obligation to conduct exploration of outer space, including the Moon and other celestial bodies 'so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extra-terrestrial matter . . .'. For a detailed discussion of this provision, see S. Marchisio, 'Article IX', in S. Hobe, B. Schmidt-Tedd and K-U. Schrogl (eds) op. cit., pp. 169–82.

33 See Moon Agreement, Art. 7.

34 See 1992 Nuclear Power Source Principles and United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) Scientific and Technical Sub-Committee and International Atomic Energy Agency (AIEA), *Safety Framework for Nuclear Power Source Applications in Outer Space* (2009). Online. Available HTTP: <http://www.fas.org/nuke/space/iaea-space.pdf> (accessed 17 February 2011).

35 See e.g. *International Cooperation in the Peaceful Uses of Outer Space* (2008), GA Res 62/217, UN GAOR, 62nd Sess, UN Doc A/RES/62/217, which (at para. 26) endorsed *The Space Debris Mitigation Guidelines of the United Nations Committee on the Peaceful Uses of Outer Space* (A/62/20), (at para. 27) agreed that 'the voluntary guidelines for the mitigation of space debris reflect the existing practices as developed by a number of national and international organizations', and (at para. 28) considered it 'essential that Member States pay more attention to the problem of collisions of space objects, including those with nuclear power sources, with space debris, and other aspects of space debris'. See also *International Cooperation in the Peaceful Uses of Outer Space* (2010), GA Res 65/97, UN GAOR, 65th Sess, UN Doc A/RES/65/97, para. 8.

> national control is now part of the corpus of international law relating to the environment.[36]

States are therefore obliged to exercise their general right to explore and use outer space, as specified in Article I of the Outer Space Treaty, with due regard also to the protection of the global environment. They have a continuing duty to take appropriate measures to prevent, minimise and control the environmental harm potentially resulting from their space activities, whether these are carried on by governmental agencies or by non-governmental entities.

This continuing duty to take appropriate measures to prevent, minimise and control potential environmental harm equates to an obligation for states to act with due diligence. It is an obligation of conduct rather than of result. Such due diligence necessitates, first, the close monitoring of scientific knowledge, technological developments and standards, and secondly, a prompt transposition of new scientific and technological findings into policies and rules applicable to public and private undertakings.

In this context, internationally agreed guidelines or standards, such as the Committee on Space Research (COSPAR) Planetary Protection Policy,[37] the UN Space Debris Mitigation Guidelines,[38] or the STSC (Scientific and Technical Subcommittee)/IAEA (International Atomic Energy Agency) Safety Framework for Space Nuclear Power Source Applications,[39] take on considerable significance by providing international benchmarks. It is to these specific areas that this chapter now turns.

Legal regulation of the space environment – specific areas of concern

Planetary protection

The seeds for the concept of protection against both forward and backward contamination have been sowed in the second sentence of Article IX of the Outer Space 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

36 [1996] ICJ Rep 226, para. 29.

37 The current version of the COSPAR Planetary Protection Policy, 20 October 2002, amended up to 24 March 2011, is online. Available HTTP: <cosparhq.cnes.fr/Scistr/PPPolicy%20(24Mar2011).pdf> (accessed 15 September 2011).

38 Adopted by the Scientific and Technical Subcommittee of UNCOPUOS at its 44th session in 2007, A/AC.105/890, para. 99, and endorsed by the *International Cooperation in the Peaceful Uses of Outer Space* (2008), GA Res 62/217, UN GAOR, 62nd Sess, UN Doc A/RES/62/217. Online. Available HTTP: <http://www.unoosa.org/pdf/pres/lsc2009/pres-06.pdf> (accessed 15 September 2011) .

39 UNCOPUOS and the International Atomic Energy Agency (IAEA), 2009, UN Doc A/AC.105/934; for further details, see L. Summerer and U.M. Bohlmann, 'The STSC/IAEA Safety Framework for Space Nuclear Power Source Applications – Influence of Non-binding Recommendations', in I. Marboe (ed.) *Soft Law in Outer Space. The Function of Non-Binding Norms in International Space Law*, Vienna: Böhlau, 2012.

> the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose.[40]

This concept has been transformed into concrete recommendatory guidelines through its implementation in the form of COSPAR's Planetary Protection Guidelines. The Committee on Space Research was established in October 1958 by the International Council of Scientific Unions (ICSU). It is an interdisciplinary scientific committee concerned with scientific research and defines itself as a non-political organisation. Its Panel on Planetary Protection is concerned on the one hand with biological interchange in the conduct of solar system exploration, including possible effects of contamination of planets other than the Earth, and of planetary satellites within the solar system by terrestrial organisms and, on the other hand, with contamination of the Earth by materials returned from outer space carrying potential extraterrestrial organisms.

The planetary protection policy of COSPAR is maintained and promulgated for the reference of space-faring nations, both as an international standard on procedures to avoid organic constituent and biological contamination in space exploration, and also to provide accepted guidelines to aid in compliance with the wording of Article IX of the Outer Space Treaty, as well as other relevant international agreements. The policy bases itself on the statement by DeVincenzi et al. of 1983:

> Although the existence of life elsewhere in the solar system may be unlikely, the conduct of scientific investigations of possible extraterrestrial life forms, precursors, and remnants must not be jeopardized. In addition, the Earth must be protected from the potential hazard posed by extraterrestrial matter carried by a spacecraft returning from another planet. Therefore, for certain space mission/target planet combinations, controls on contamination shall be imposed, in accordance with issuances implementing this policy.[41]

Different categories are established for space mission/target body combinations and respective suggested ranges of requirements, based on the degree of interest they represent for

40 Outer Space Treaty, Art. IX in its entirety provides as follows:

> 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 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. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.

41 D.L. DeVincenzi, P.D. Stabekis and J.B. Barengoltz, 'A Proposed New Policy for Planetary Protection', *Advances in Space Research* 3, 1983, 13.

an understanding of the process of chemical evolution, or the origin of life.[42] Rather precise technical procedural instructions are proposed for each possible combination. The policy remains flexible, in that it can be updated fairly easily, in order to adapt swiftly to new scientific insights and understanding.[43]

Space-faring nations and the relevant international organisations have made it their declared policy to take into account the COSPAR Planetary Protection Guidelines in the definition of requirements for their respective missions.[44] Although the legal status of these policies remains that of internal documents that do not directly give rise to internationally binding commitments, they may provide guidance in the assessment of international benchmarks that are applicable to any required conditions of 'due diligence'.

The use of nuclear power sources in outer space

The risks associated with the use and application of nuclear power sources (NPS) led to the adoption of the Nuclear Power Source Principles in 1992. Although they do not create binding commitments under general public international law, the Nuclear Power Source Principles do provide some guidance.[45] The preamble of the Nuclear Power Source Principles already recognises that, for some missions in outer space, NPS are particularly suited, or even essential, due to their particular qualities.[46] The first paragraph of Principle 3 of the Nuclear Power Source Principles contains the general provision that:

> [i]n order to minimize the quantity of radioactive material in space and the risks involved, the use of nuclear power sources in outer space shall be restricted to those space missions which cannot be operated by non-nuclear energy sources in a reasonable way.

What factors are to be taken into account, and how to weigh these in order to establish 'reasonableness', is left to the discretion of those states contemplating the use of NPS. What is

42 COSPAR Planetary Protection Policy. Online. Available HTTP: <http://cosparhq.cnes.fr/Scistr/PPPolicy%20(24Mar2011).pdf> (accessed 1 November 2011).

43 See e.g. details of the recent changes incorporated at the 2008 COSPAR Assembly in Montréal in C. Conley and P. Rettberg, 'COSPAR Planetary Protection Policy – Present Status', in M. Hofmann, P. Rettberg and M. Williamson (eds) *IAA 2010 Cosmic Study: Protecting the Environment of Celestial Bodies*, 2010, p. 16 onwards.

44 One prominent example is the NASA Policy Directive NPD 8020.7G, *Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*, Revalidated 25 November 2008. Online. Available HTTP: <http://nodis3.gsfc.nasa.gov/npg_img/N_PD_8020_007G_/N_PD_8020_007G__main.pdf> (accessed 15 September 2011), together with its implementing procedures and guidelines contained in 8020.12D, *Planetary Protection Provisions for Robotic Extraterrestrial Missions*, Effective Date: 20 April 2011. Online. Available HTTP: <http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=8020&s=12D> (accessed 15 September 2011).

45 For a comprehensive analysis of the Principles and their legal significance see D.A. Porras, 'The United Nations Principles Relevant to the Use of Nuclear Power Sources in Outer Space: the significance of a soft law instrument after nearly 20 years in force', in I. Marboe (ed.) op. cit. For a general overview of international law regarding nuclear energy, see M. Elbaradei, E. Nwogugu and J. Rames, 'International law and nuclear energy: overview of the legal framework'. Online. Available HTTP: <http://www.iaea.org/Publications/Magazines/Bulletin/Bull373/37302081625.pdf> (accessed 15 September 2011), where the authors discuss the mix of legally binding rules and agreements on the one hand, and advisory standards and regulations on the other.

46 The intensity of solar radiation decreases exponentially with the distance from the Sun. As a consequence, nuclear power sources constitute the only available option to supply sufficient heat and electricity to spacecraft at the orbit of Jupiter or beyond.

particularly interesting about Section 1 of Principle 3, which lays down 'General goals for radiation protection and nuclear safety', is the fact that it requires not only that individuals, populations and the biosphere be protected against radiological hazards in operational and accidental circumstances, but also that:

> the design and use of NPS shall ensure with high reliability that radioactive material does not cause a significant contamination of outer space.

Sections 2 and 3 of Principle 3 of the Nuclear Power Source Principles proceed to establish specific guidelines for the use of nuclear reactors on the one hand, and radio-isotope generators on the other. Principle 4 stipulates that a launching state (as defined in Principle 2)[47] has to ensure that a thorough and comprehensive safety assessment is conducted, the results of which shall be made publicly available prior to each launch. Furthermore, Principle 5 of the Nuclear Power Source Principles contains provisions as to notification in case of re-entry of satellites with nuclear power sources on board.[48]

The main objective of the 2009 Safety Framework for Nuclear Power Source Applications in Outer Space (2009 Safety Framework)[49] is to:

> protect people and the environment in Earth's biosphere from potential hazards associated with relevant launch, operation and end-of-service phases of space nuclear power source applications.

Neither the extraterrestrial environment, nor humans in outer space, is included within the scope of protection. The 2009 Safety Framework is intended to provide technical guidance only. It has not been drafted as a legally binding instrument. In its preface, it is expressly stated that it is not legally binding under international law, and that it is not a publication in the IAEA Safety Standards Series with the corresponding legal implications,[50] but rather is

47 Principle 2 of the Nuclear Power Source Principles provides as follows:

> For the purpose of these Principles, the terms 'launching State' and 'State launching' mean the State which exercises jurisdiction and control over a space object with nuclear power sources on board at a given point in time relevant to the principle concerned.

48 Principle 5 builds on the stipulations of the 1986 Convention on Early Notification of a Nuclear Accident, INFCIRC/335. This duty to inform 'States concerned' and the United Nations Secretary-General is supplemented by the 1987 Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, INFCIRC/336. For a detailed discussion on the relationship between the Nuclear Power Source Principles and these Conventions, see M. Benkö, 'Nuklearenergie im Weltraum', in K-H. Böckstiegel (ed.) *Handbuch des Weltraumrechts*, Cologne: Carl Heymanns Verlag, 1991, 457, p. 475.

49 United Nations Committee on the Peaceful Uses of Outer Space and IAEA (2009), UN Doc A/AC.105/934; see also Summerer and Bohlmann, op. cit.

50 According to Article III.A.6. of its Statute, the IAEA is authorised to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the UN and with the specialised agencies concerned, standards of safety for protection of health and minimisation of danger to life and property (including such standards for labour conditions), and to provide for the application of these standards to its own operations as well as to the operations, making use of materials, services, equipment, facilities and information made available by the Agency or at its request or under its control or supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangements, or, at the request of a state, to any of that state's activities in the field of atomic energy; see H. Blix, 'The Role of the IAEA in the Development of International Law', *Nordic Journal of International Law* 58, 1989, 231.

intended to complement the IAEA Safety Standards with appropriate guidance concerning the particular aspects resulting from the specific characteristics of space NPS applications compared to NPS applications on Earth. It is a model framework that represents the state of the art in the use of NPS applications in outer space, and transposes this into 'guidance': guidance for government, management and technical guidance.

The guiding principles directed to those governments and relevant international intergovernmental organisations that authorise, approve or conduct space NPS missions addresses not only regulatory aspects, namely the establishment of, and ensuring compliance with, safety policies, requirements and processes, verification of the justification put forward for the use of an NPS, and the establishment of a dedicated, supplementary nuclear launch authorisation process, but also direct governmental activities, such as preparation for emergency preparedness and response.

The guidance for management section addresses all organisations involved with NPS space applications. The technical guidance provided for in the safety framework relates to the design, development and mission phases of space NPS applications, and encompasses key areas for developing and providing a technical basis for authorisation and approval processes, as well as for emergency preparedness and response.

Even though neither the Nuclear Power Source Principles, nor the 2009 Safety Framework give rise to binding commitments, voluntary compliance with the guiding principles they provide seems advisable, since it ensures that space activities involving the use of NPS are carried out in a 'state of the art' manner, thereby fulfilling any due diligence requirements that might be applied.

Space debris

The issue of space debris is a major area for environmental concern, which clearly impacts also upon human safety. For example, on 12 March 2009, the three astronauts aboard the International Space Station (ISS), Americans Mike Fincke and Sandra Magnus and Russian Yuri Lonchakov, were forced to evacuate the main station and remain in the ISS escape vehicle for nine minutes, while a piece of debris about 1 centimetre in length passed by.[51] Had the debris hit and pierced the ISS, it is possible that a fatal loss of air pressure could have ensued. More recently, the six-man crew on the ISS was again forced to take shelter in two *Soyuz* craft on 28 June 2011, when another piece of debris drifted past the station.[52]

Only one month before the March 2009 incident, an operational American commercial satellite (*Iridium 33*) and an inactive Russian communications satellite (*Kosmos 2251*) collided approximately 790 km above the Earth, resulting in the total destruction of both. This was the first time that two intact satellites had collided, and the collision resulted in approximately

51 See e.g. M. McKee, 'Debris Threat Prompts Space Station Crew to Evacuate' *New Scientist*. Online. Available HTTP: <http://www.newscientist.com/article/dn16755-debris-threat-prompts-space-station-crew-to-evacuate.html> (accessed 26 July 2011).

52 'Space Debris forces ISS astronauts to evacuate the station'. Online. Available HTTP: <http://thewatchers.adorraeli.com/2011/06/29/space-debris-forces-iss-astronauts-to-evacuate-the-station/> (accessed 26 July 2011).

700 additional pieces of hazardous debris being created, with the potential to cause additional decades-long pollution in space.[53]

Adding to the complexity of the issue, in 2007 and 2008 respectively, both China and the United States proceeded to deliberately destroy their own satellites in space, thus causing additional space debris from the resultant explosions.[54]

According to the United States Space Surveillance Network, 4,765 launches and 251 in-orbit break-ups have led to 16,200 objects being catalogued.[55] Approximately 77 per cent of these objects are in low Earth orbits, 6 per cent are in near-geostationary orbits, 10 per cent in highly eccentric orbits and 7 per cent in other orbits, including GNSS (global navigation satellite system) orbits.[56] Some 20 per cent of the catalogued objects constitute satellites (of which only 6 per cent are operational), 11 per cent are rocket bodies, 5 per cent are mission-related objects and 64 per cent constitute fragments.[57]

Even before the more recent high-profile incidents referred to above, it had been recognised that this environment causes an ever increasing collision hazard for man-made satellites. For this reason, it was decided as early as 1993 to establish among interested space agencies an Inter-Agency Space Debris Coordination Committee (IADC), which is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space. According to its terms of reference:

> [t]he primary purpose of the IADC is to exchange information on space debris research activities between member space agencies, to facilitate opportunities for cooperation in space debris research, to review the progress of ongoing cooperative activities and to identify debris mitigation options.[58]

The IADC Space Debris Mitigation Guidelines[59] were formally adopted by consensus in October 2002 during the Second World Space Congress in Houston, Texas. They:

> describe existing practices that have been identified and evaluated for limiting the generation of space debris in the environment. The Guidelines cover the overall environmental impact of the missions with a focus on the following:

53 *NASA orbital debris quarterly news* 13(2), 2009, pp. 1–2. Online. Available HTTP: <http://www.orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv13i2.pdf> (accessed 1 November 2011); 'Russian and US Satellites Collide', BBC News. Online. Available HTTP: <http://news.bbc.co.uk/2/hi/science/nature/7885051.stm> (accessed 12 March 2012).

54 For background to these two incidents, see S. Freeland, 'The 2008 Russia/China Proposal for a Treaty to Ban Weapons in Space: A Missed Opportunity or an Opening Gambit?', *Proceedings of the Colloquium on the Law of Outer Space* 51, 2008, American Institute of Aeronautics and Astronautics, pp. 261–71.

55 Status as of December 2010.

56 H. Klinkrad, *Space Debris Mitigation Activities at ESA*, Presentation to the Scientific and Legal Subcommittee of the UN Committee on the Peaceful Uses of Outer Space, February 2011. Online. Available HTTP: <http://www.oosa.unvienna.org/pdf/pres/stsc2011/tech-40.pdf> (accessed 1 November 2011).

57 This figure was 41 per cent before the 2007 Chinese *FengYun 1C* ASAT (anti-satellite) test and the 2009 collision between *Iridium 33* and *Kosmos 2251*.

58 Online. Available HTTP: <http://www.iadc-online.org/index.cgi?item=torp> (accessed 15 September 2011).

59 Available in their current version, revision 1 of September 2007. Online. Available HTTP: <http://www.iadc-online.org/index.cgi?item=docs_pub> (accessed 15 September 2011).

(1) Limitation of debris released during normal operations;
(2) Minimisation of the potential for on-orbit break-ups;
(3) Post-mission disposal;
(4) Prevention of on-orbit collisions.[60]

The IADC presented its guidelines to the UNCOPUOS STSC, where they served as a baseline for the development of the UN Space Debris Mitigation Guidelines. In 2007, the UNGA endorsed the Space Debris Mitigation Guidelines as adopted by the UNCOPUOS STSC, and agreed that the voluntary guidelines for the mitigation of space debris reflected the existing practices as developed by a number of national and international organisations.[61] It invited member states to implement those guidelines through relevant national mechanisms.

The document recognises two broad categories of space debris mitigation measures: those that curtail the generation of potentially harmful space debris in the near term – the curtailment of the production of mission-related space debris and the avoidance of break-ups – and those that limit their generation over the longer term – end-of-life procedures that remove decommissioned spacecraft and launch vehicle orbital stages from regions populated by operational spacecraft.

The seven numbered guidelines remain at a generalised level and encourage, on a voluntary basis, actions that would:

(1) limit debris released during normal operations;
(2) minimise the potential for break-ups during operational phases;
(3) limit the probability of accidental collision in orbit;
(4) avoid intentional destruction and other harmful activities;
(5) minimise potential for post-mission break-ups resulting from stored energy;
(6) limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit region after the end of their mission;
(7) limit the long-term interference of spacecraft and launch vehicle orbital stages with geosynchronous region after the end of their mission.[62]

The transformation in character that the guidelines have experienced in their passage from the IADC through to the United Nations system and specifically the UNCOPUOS can easily be attributed to the different composition of the fora, as well as their different focus and scope. Whereas the IADC is an open association of technical entities of space-faring nations, the UN incorporates the representatives of states, both space-faring and non-space-faring. The motivations of the IADC members are far more homogeneous than the different positions of member states of UNCOPUOS. The focus of IADC is very technical, whereas UNCOPUOS is, in addition, more politically influenced, readily taking into account the positions of member states in other debates.

60 Section 1 of the guidelines; see also N.L. Johnson, 'Developments in Space Debris Mitigation Policy and Practices', in *Proceedings of the Institution of Mechanical Engineers, Part G, Journal of Aerospace Engineering* 221(6), 2007, pp. 907–9.
61 *International Cooperation in the Peaceful Uses of Outer Space* (2008), GA Res 62/217, UN GAOR, 62nd Sess, UN Doc A/RES/62/217.
62 The document is online. Available HTTP: <http://www.unoosa.org/pdf/publications/st_space_49E.pdf> (accessed 1 November 2011).

It is therefore not surprising that the IADC Guidelines go into much more technical detail than the UN guidelines. Being more easily able to be amended also facilitates this greater emphasis on technical issues. The UN guidelines make a clear reference to the version of the IADC Space Debris Mitigation Guidelines at the time they (the UN guidelines) were themselves published,[63] but they also invite member states and international organisations to:

> refer to the latest version of the IADC space debris mitigation guidelines and other supporting documents, which can be found on the IADC website, . . . for more in-depth descriptions and recommendations pertaining to space debris mitigation measures.[64]

From a legal perspective, neither of the sets of guidelines is binding under international law. Over the years there have also been repeated attempts to bring the subject of space debris onto the agenda of the Legal Subcommittee of UNCOPUOS in one way or another, but so far with only limited success.[65] Member states shy away from any legal discussion of the matter, a behavioural pattern that can also be observed with regard to other subject matters connected to aspects of the sustainability and environmental impacts of space activities. Nevertheless, states and space agencies implement the guidelines, aware of the fact that such implementation serves their own interests in keeping the relevant orbits accessible and useable.[66] However, the point at which they consider themselves ready to commit internationally, in exchange for the same commitment from other states, seems not to have thus far been reached.[67]

Space debris and its cascading effects have been identified as one of the greatest challenges for the long-term sustainability of space activities. Still, the existing international texts as presented above can be characterised as 'soft law' at best. By implementing the guidelines contained in these soft-law instruments via national or agency policies, policy-makers might,

63 As contained in the annex to the *Inter-Agency Space Debris Coordination Committee Space Debris Mitigation Guidelines* (2002), UNCOPUOS, UN Doc A/AC.105/C.1/L.260.

64 Ibid., Chapter 6.

65 The item 'General exchange of information on national mechanisms relating to space debris mitigation measures' has appeared on the Agenda of the Legal Subcommittee of UNCOPUOS since its 48th session in 2009. The latest attempt to give the debate a clear legal impetus was in the form of a Working Paper submitted by the Czech Republic to the Legal Subcommittee of UNCOPUOS proposing as a new agenda item the review of the legal aspects of the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, with a view to transforming the Guidelines into a set of principles to be adopted by the General Assembly, UN document A/AC.105/C.2/L.283. This initiative gained support from quite a number of other member states, but could not secure the required consensus in order to give rise to a new agenda item.

66 For example, NASA has developed its Procedural Requirements for Limiting Orbital Debris, NPR 8715.6A. Effective Date 14 May 2009, Expiration Date 14 May 2014. Online. Available HTTP: <http://nodis3.gsfc.nasa.gov/npg_img/N_PR_8715_006A_/N_PR_8715_006A_.pdf> (accessed 15 September 2011), which requires formal assessments and disposition plans.

67 Taking again the NASA Procedural Requirements as an example, one should note that the policy states in its Chapter 1.1.3 that compliance with this NPR meets the guidelines and intent of the following documents (as of the date of this NPR): the US Government Orbital Debris Mitigation Standard Practices and the IADC-0201, Space Debris Mitigation Guidelines. Yet, it is also very clear on its internationally non-binding character: 'This NPR shall not be construed as conferring upon any international body, agency, or committee the right to place upon the U.S. Government or NASA any restrictions or conditions as to its space operations unless required by separate agreement or treaty', Chapter P.1.7.

however, ultimately contribute to the formation of a due diligence standard, if international practice is sufficiently widespread and representative.

Conclusion

In general terms, the existing body of international space law does not provide a comprehensive legal framework for the protection of the environment of outer space, nor does it specify rigorous environmental standards in relation to the conduct of space activities, either in space or on Earth, for example, with respect to launch activities. Moreover, even the rather general obligations relating to environmental aspects of the exploration and use of outer space that are found in the United Nations Space Treaties are not particularly well suited to more recent developments in the exploration and use of outer space. Such concerns will only become more pressing given the likelihood of increased human spaceflight activities, including the proposed advent of a commercial 'space tourism' industry over the coming years and decades.

In addition, the Outer Space Treaty reaffirms that 'international law' applies to 'activities in the exploration and use of outer space'.[68] However, it is not entirely clear how readily the general principles of international law that have been developed primarily in respect of terrestrial activities can be applied to the unique characteristics of space activities, although outer space, as one of the 'areas beyond the limits of national jurisdiction', is considered to be included within the protection of Principle 21 of the 1972 Stockholm Declaration and Principle 2 of the 1992 Rio Declaration on Environment and Development.[69]

To further complicate matters, many space activities are now undertaken by non-governmental commercial entities, which are not *per se* bound by the United Nations Space Treaties,[70] but rather are subject to local laws and the provisions negotiated in commercial launch service contracts, both of which will vary considerably in the particular circumstances.

Yet, as has been indicated above, there are a number of areas related to the space environment that are increasingly giving cause for concern. One obvious area – among several – is that of space debris, which potentially threatens all space activities and, as a consequence, the future of space exploration and use.

To properly address such issues requires close cooperation among all space-faring (and other) states – something that is difficult (though not impossible) given the highly strategic role that space activities play for each state's security, military and commercial interests. Moreover, it is generally agreed that the implementation of binding 'greener' space regulations would significantly increase the costs associated with space activities, at least in the short to medium term. It is not at all clear that space-faring states would be prepared to carry such

68 Outer Space Treaty, Art. III.

69 *Declaration of the United Nations Conference on Environment and Development* (1992), UN Doc A/CONF.151/26 (Volume 1), 31 ILM 874 ('Rio Declaration').

70 Outer Space Treaty, Art. VI does, however, provide that:

> States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty.

additional burdens, a situation that is exacerbated further by the current somewhat uncertain state of the world's financial markets and economic outlook.

However, there is a clear commonality of interests in addressing those environmental issues relating to outer space that might unduly impede or restrict humankind's activities in space. The problems will become – if they have not already done so – too large and complex for any one state, or group of states, to be able to deal with alone. The future regulation of outer space necessitates common approaches and commitments. The antecedents of this can already be seen in the form of soft-law instruments that are intended to fill various 'gaps' in the existing corpus of international space law. It is to be hoped that the continuation of this cooperative approach to space law-making will ultimately lead to the codification of new and emerging principles dealing with environmental issues in hard law treaties, with the acceptance of all relevant states. This will complement and expand upon those fundamental rules that already exist in the various United Nations Space Law Treaties.

This is not to ignore the fact that there are many issues that represent considerable challenges as to how international law, incorporating the international legal regulation of outer space, will be able to cope with future activities in space, and their consequences for the outer space environment. The way in which the rules are developed and adapted to meet these challenges will be important not only for outer space itself, but also for future generations living on Earth. This is absolutely necessary for the continued peaceful use of outer space in the future for the benefit of all humankind. Humankind's use of outer space should reflect underlying notions of cooperation and shared benefit, which must remain as the cornerstones in this next phase of human achievement. International law has a crucial part to play in this regard.