Kaja Hopej[1]

Sustainable Development in the Light of Damage Caused to the Outer Space Environment

Introduction

Adequate definition and identification of a specific phenomenon often has the effect of protecting it more effectively. Ensuring the safety of the outer space environment in the context of sustainable development is of particular importance, especially in the era of New Space. Under the existing space law, environmental regulations are negligible, and rather general in nature (such as those contained in the Outer Space Treaty)[2], not to mention the inclusion of the space environment in the definition of damage, or the rare implementation of the definition of space debris in National Space Legislations. Concerning the space environment, there are currently not many provisions to broadly protect it or clearly define the issue of damages caused in outer space, in particular the problem of space debris which affect safety, security and peace – the fundamental principles of sustainable development.[3]

The stakeholders of the space sector are aware of the dynamic situation that is associated with the growing number of space activities. Risks arising from improperly adopted measures or failure to adequately assess these risks

[1] Central European Academy, Budapest, Hungary – Centre for Space Studies, Kozminski University, Warsaw, Poland; e-mail: kajahopej@gmail.com; ORCID: 0000-0002-4001-4576

[2] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies refers to the protection of the environment in particular Article IX where it imposes an obligation on States Parties to the Treaty to conduct space research and exploration of outer space, including the moon and other celestial bodies so as to avoid their harmful contamination as well as to adverse changes in the Earth's natural environment (as a result of the introduction of extraterrestrial matter).

[3] The 2030 Agenda for Sustainable Development containing the Sustainable Development Goals (SDGs) was adopted by a General Assembly Resolution 70/1 on 25 September 2015 in New York by all 193 UN members.

https://doi.org/10.36250/01192_04

can have huge consequences not only in terms of environmental pollution but also in the functioning of the entire space ecosystem. Miniaturised systems and large constellations only increase the danger of contamination of the space environment. The absorption capacity of the generated debris in space, like on Earth, seems to be limited.[4] Because of this rapid increase due to the amount of orbital debris there is a high probability of the so-called Kessler Syndrome.[5] The consequence of such a phenomenon may be the uselessness of orbits with a higher value or even complete lack of access to them.[6] Moreover, recent events regarding numerous collision hazards or the direct-ascent anti-satellite test (DA-ASAT)[7] outlines the question of consequences for intensified space activities. Proper recognition of the deployment of risks associated with environmental damage is essential to the sustainability of space activities. The scale of this phenomenon highlights the need to implement appropriate regulations, at both the international and national level to reduce the risk of environmental damage. It is for this reason that a number of dialogues, agreements and guidelines are being undertaken to meet the challenges of sustainable development in outer space.

The aim of this article is to present the regulatory mechanisms as well as measures in order to ensure sustainable development in the space sector and in particular to examine the regulations for the identification of damage to the outer space environment. The author seeks to provide an overview of the different approaches to defining damage to the terrestrial environment and, by analogy, intends to present the possibility of defining damage caused to the outer space environment (based on various definitions of damage and space debris).

[4] Stubbe 2017.

[5] The Kessler Syndrome is a theory used to describe a self-sustaining cascading collision of space debris, i.e. when the amount of debris in orbit reaches a critical point that leads to collisions between already existing objects, creating more and more space debris.

[6] OECDiLibrary s. a.

[7] On 15 November 2021, Russia conducted a direct-ascent anti-satellite (DA-ASAT) test, destroying one of its own space objects (a defunct Soviet satellite, Cosmos 1408). As a result of this activity, thousands of new debris appeared in outer space which threatened the astronauts on the International Space Station (ISS). They had to implement evacuation measures.

The concept of long-term sustainability of outer space activities

The definition of long-term sustainability of outer space activities

The definition of long-term sustainability of outer space activities appears in the *Guidelines for the Long-Term Sustainability of Outer Space Activities* (LTS Guidelines).[8] It is defined as "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". The issue of securing the space environment in the cited definition plays a major role. A cessation of the relevant activities carried out in this direction may consequently lead to a lack of opportunity to explore outer space in the future. Due to the critical level of space debris orbiting the Earth,[9] the fundamental principle under 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 (Outer Space Treaty) of equal access to space exploration and use is under threat.[10]

Nevertheless, one should be noted that the issue of sustainability has its origins in the already well-established International Space Law. Provisions regarding this matter are found in Article IX of the Outer Space Treaty,[11] in the Convention on Registration of Objects Launched into Outer Space (Registration Convention) through the registration of space objects, in the Convention on International Liability for Damage Caused by Space Objects (Liability Convention) as well as in the Article 7[12] of the Agreement Governing the Activities of States on the Moon

[8] Doc. A/AC.105/2018/CRP.20.

[9] NASA 2021.

[10] NetZeroSpace 2022: 7.

[11] Article IX: "[…] 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 […]."

[12] Article 7: "In exploring and using the Moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the Earth through the introduction of extraterrestrial matter or otherwise."

and Other Celestial Bodies (Moon Agreement).[13] However, only the provisions of the Moon Agreement directly address the protection of the environment and celestial bodies.[14]

The concept of sustainable development in existing regulations

The concept of sustainable development of space activities have already been implemented in several National Legislations. An example is the Finish Act on Space Activities from 2018 which explicitly indicates that the "space activities shall be carried on in a manner that is environmentally sustainable and promotes sustainable use of outer space".[15] Indirectly, the issue of environmental protection is indicated by the French Space Operational Act from 2008 which includes environmental protection (in particular the mitigation of space debris) as part of the requirements for obtaining authorisations and licenses.[16] The notion of long-term sustainable use of space has also emerged in the Polish draft law on space activities from 2020 where Article 9 stipulates that space activities carried out at any stage shall, in particular, be carried out in respect of long-term sustainable use of outer space for peaceful purposes and should eliminate or reduce (as much as possible) the negative impact on the Earth's environment and in outer space.[17] It should be noted that environmental issues such as space debris mitigation can be binding at various levels. In practice, requirements can be binding by law, license or at contractual level as in the case of the German Space Agency (DLR)[18] procurement contracts.[19]

For the purposes of this study, in addition to international principles derived from space treaties, particular emphasis is placed on recommended international

[13] Hofmann 2022.

[14] Hobe 2019.

[15] *Laki avaruustoiminnasta* (Finnish Act On Space Activities 63/2018); Chapter 2, Section 10.

[16] LOI n° 2008-518 du 3 juin 2008 relative aux opérations spatiales (1) (French Space Operations Act, No. 2008-518 2008); Article 5.

[17] Polish Draft Act on Space Activities of 10 June 2020. Work on the basis of the 2020 project have been resumed as part of the Working Group for the Development of the Draft Act on Space Activities established in January 2021 within the Ministry of Development and Technology, in which the author of this article actively participated.

[18] *Deutsches Zentrum für Luft- und Raumfahrt.*

[19] NetZeroSpace 2022: 11.

standards and National Space Legislation (NSL) covering, inter alia, the issue of protection of the environment, space debris as well as the definition of damage caused to the outer space environment.

Definition of environmental damage

Definitions of environmental damage (caused in particular to the Earth's land surface, minerals, water, air, landscape and climate) appear in various legal documents. One example is the EU Environmental Liability Directive (ELD)[20] where environmental damage includes damage to protected species and natural habitats,[21] water damage[22] and land damage.[23] In 2021, the European Commission adopted guidelines that clarify the scope of this concept in the ELD and which is based on established case law.[24] The definition of environmental damage can also be found in Recital 24 of Regulation (EC) No 864/2007 of the European Parliament and of the Council of 11 July 2007 on the law applicable to non-contractual obligations (Rome II Regulation) stating that "environmental damage should be understood as meaning adverse change in a natural resource, such as water, land or air, impairment of a function performed by that resource for the benefit of another natural resource or the public, or impairment of the variability among living organisms".[25] Another example of environmental damage may also be seen in U.S. law where The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in § 107(a)(4)(C) provides liability

[20] Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage ELD, 2004/35/WE.

[21] "Which is any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. The significance of such effects is to be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I."

[22] "Which is any damage that significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential, as defined in Directive 2000/60/EC, of the waters concerned, with the exception of adverse effects where Article 4(7) of that Directive applies."

[23] "Which is any land contamination that creates a significant risk of human health being adversely affected as a result of the direct or indirect introduction, in, on or under land, of substances, preparations, organisms or micro-organisms".

[24] European Commission s. a.

[25] Recital 24 of the Rome II Regulation Preamble.

for "damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release".[26]

Damage in national space legislations

Definition of damage

Protection of the outer space environment arises in the context of National Space Legislations. Some countries such as France and the United Arab Emirates (UAE) have chosen to define the concept of damage separately in their internal regulations. In case of France or Luxembourg (as indicated in the table below) this definition also refers to environmental damage. The Kazakh space regulations only refer to environmental damage, but do not define damage per se.

Table 1: Examples of definitions of damage in the national space legislations

Country	Definition of damage	Definition content
France[27]	Yes	"*Damage* means any harm to persons, property, including public health or the environment, directly caused by a space object in the course of a space operation, excluding the consequences for users of the signal emitted by that object."
Sweden[28]	No	–
Luxembourg[29]	Yes	"*Damage* means any harm to persons, property, public health or the environment directly caused by a space object in the course of a space activity, excluding the consequences for users of the signal emitted by that object."

[26] Comprehensive Environmental Response, Compensation, and Liability Act, Section 107(a)(4)(C).

[27] Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales (1) (French Space Operations Act, No. 2008-518 2008), Article 1.

[28] Lag om rymdverksamhet (Act on Space Activities 1982:963).

[29] Loi portant sur les activités spatiales et modifiant: 1° la loi modifiée du 9 juillet 1937 sur l'impôt sur les assurances dite «Versicherungssteuergesetz»; 2° la loi modifiée du 4 décembre 1967 concernant l'impôt sur le revenue (Law of 15 December 2020 on Space Activities and amending: 1° the amended law of 9 July 1937 on the tax on insurance known as "Versicherungssteuergesetz" 2° the amended law of 4 December 1967 concerning income tax), Article 2.

Country	Definition of damage	Definition content
UAE[30]	Yes	"The damage referred to in Clause (1) of this Article means loss of life, personal injury, or any other harm to health, or the loss or damage that is caused to the property of the State, the property of Persons, or the property of intergovernmental organisations."
Kazakhstan[31]	No	–
Belgium[32]	Yes	"*Damage* means any damage as defined by the first Article of the Convention on International Space Liability. Pursuant to this law, the liability of the Belgian State in respect of such damage extends in addition to Belgian citizens, whether they are natural or legal persons, except for those participating in the activities in question."

Source: Malinowska et al. 2022

From the perspective of international space law, it should be emphasised that the definition of damage contained in the Liability Convention refers to damage to a person and property, disregarding the environmental damage.[33] As mentioned above, only the Moon Agreement in Article 7 refers to protection of celestial bodies as well as the outer space environment.

Definition of space debris

Noticeably fewer countries decided to define the space debris themselves. The United Arab Emirates defines space debris as a "Space Object that has no role or purpose, or the remains thereof, and the materials, waste, or fragments resulting therefrom, whether in Outer Space, including the Earth's orbit, or inside the Earth's atmosphere".[34] The United Kingdom used the term 'fragmentation debris'

[30] Federal Law No. (12) of 2019 Issued on 19/12/2019 Corresponding to 22 Rabi' Al-Akhar 1441H. On the Regulation of the Space Sector, Article 20.

[31] О космической деятельности (Law of the Republic of Kazakhstan on Space Activities No. 528-IV of 6 January 2012).

[32] Loi relative aux activités de lancement, d'opération de vol ou de guidage d'objets spatiaux (Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects), Article 3.

[33] Article 1 of the Liability Convention.

[34] Federal Law No. (12) of 2019 Issued on 19/12/2019 Corresponding to 22 Rabi' Al-Akhar 1441H. On the Regulation of the Space Sector, Article 1.

which according to the Space Industry Regulations 2021 means "debris that is emitted as a result of an explosion or deflagration".[35] It is also common to refer to definitions of space debris proposed by, for example, the European Space Agency[36] or the Inter-Agency Space Debris Coordination Committee (IADC).[37]

The inclusion of a separate definition of damage in the National Space Legislation is at the discretion of the State. Some legislators choose to stay with the definition that the Liability Convention contains. In many countries, the concept of damage under the civil law system also appears to be sufficient and applicable to the definition of damage provided in the Liability Convention. Nevertheless, the combination of the definition of damage together with the definition of space debris could be the foundation and some sort of a compromise for formulating the definition of damage to the space environment as such.

Sustainable development from the soft law perspective

International guidelines

As of 7 November 2022, the number of debris objects regularly tracked by Space Surveillance Networks was about 32,340 and the total mass of all space objects in Earth orbit amounted to more than 10,400 tonnes. By comparison, in 2021 the number of cataloged space debris oscillated around 29,710[38] which in relation to the current year indicates a difference of 2,630 objects. Such a large increase in nearly 12 months undoubtedly points to an indicative growing threat that needs to be not only effectively but as quickly as possible minimised. One solution seems to be the adoption of regulations at the internal level based on already existing international recommendations in the form of guidelines and standards. An example of National Space regulations referring to the application of internationally recognised guidelines to mitigate of space debris is the Austrian

[35] UK Space Industry Regulations 2021.

[36] "Space debris is defined as all non-functional, artificial objects, including fragments and elements thereof, in Earth orbit around the Earth or re-entering into Earth atmosphere. Human-made space debris dominates the natural meteoroid environment, except around millimetre sizes."

[37] "Space debris are all man made objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non functional."

[38] ESA 2022a.

Federal Law on the Authorisation of Space Activities and the Establishment of a National Registry (Austrian Outer Space Act).[39]

Formulating guidelines and recommendations is one method of managing the growth of space debris. However, due to the non-binding nature of these recommendations, their effectiveness is questionable. Nonetheless, a slight increase in adoption and adherence to space debris mitigation practices is observed. However, this is not satisfactory enough to ensure the long-term sustainability of space activities. The application of mitigation measures, analysed through indicators, i.e. as post mission disposal success rates for payloads in LEO or rocket bodies controlled re-entries, involves the decommissioning and deployment of large constellations.[40] Heretofore, many international instructions have been published. The current set of internationally recognised guidelines related to space debris mitigation is quite substantial. These should include already mentioned LTS Guidelines from 2019, Committee on the Peaceful Uses of Outer Space (COPUOS) Space Debris Mitigation Guidelines, Inter-Agnecy Space Debris Coordination Committee (IADAC) Space Debris Mitigation Guidelines, International Organization for Standarization (ISO) Standards[41] and Technical Reports, International Telecommunications Union (ITU)[42] Recommendations and European Code of Conduct for Space Debris Mitigation. These guidelines include recommendations for the security of space operations, recommendations on the legal and policy framework, the issue of international cooperation[43] as well as technical guidance, guidance on management, design or operational measures. Harmonisation of currently existing standards should serve as a basis for countries to introduce regulations at national level so as to also reduce the risk of litigation.

In most cases, compliance with and reference to the international standards relates to the issue of licensing and authorisation of space activities. As already

[39] Article 5: "The operator has to make provision for the mitigation of space debris in accordance with the state of the art and in due consideration of the internationally recognised guidelines for the mitigation of space debris. Especially measures limiting debris released during normal operations have to be taken."

[40] ESA 2022b: 8.

[41] For example, ISO 24113:2019; Space systems – Space debris mitigation requirements, ISO/TR 16158:2021; Space systems – Avoiding collisions among orbiting objects or ISO/TR 18146:2020; Space systems – Space debris mitigation design and operation manual for spacecraft.

[42] Recommendation ITU-R S.1003.2.

[43] ESA 2022b: 9.

mentioned above, legal provisions aimed at, for example, mitigation of space debris can be binding by law or results from contractual clauses.[44] For example, the Space Administration of the German Aerospace Centre, in the implemented national space programme and in its policy, assumes that a contractor who is involved in a space mission applies appropriate requirements for, among other things, space debris mitigation at all stages of the project.[45] In case of Italy, the implementation of appropriate space debris mitigation mechanisms is limited to the provisions of the standard contracts of the Italian Space Agency (ASI).[46] An example of binding regulations at the national level that apply to space debris mitigation is the Law of Ukraine on Space Activity,[47] where Article 9 contains a prohibition on space activities in violation of international norms and standards regarding pollution of outer space.[48]

UNOOSA Resolutions

An example of other activities which are taken internationally in order to change the current state of affairs regarding the problem of pollution of the space environment are the United Nations General Assembly Resolution (UN GA Resolutions). In the context of this analysis, three of them deserve particular attention, namely the 47/68 (Principles Relevant to the Use of Nuclear Power Sources in Outer Space) Resolution from 1992, the recommendations on national legislation provided in Resolution 68/74 and the Resolution adopted by the General Assembly on 7 December 2020 (Resolution 75/36).

[44] UNOOSA 2022. For space projects of DLR, as part of the Product Assurance and Safety Requirements for DLR Space Projects *(DLR Requirements),* space debris mitigation requirements are mandatory.

[45] UNOOSA 2021: 36.

[46] UNOOSA 2021: 44.

[47] Law of Ukraine of 15 November 1996 (VVRU, 1997: 2).

[48] UNOOSA 2021: 77.

UN GA Resolution 47/68

As a consequence of the Cosmos 954 accident[49] the United Nation General Assembly adopted the Principles Relevant to the use of nuclear power sources in outer space (Resolution 47/68) which addressed to the protection of the environment in outer space.[50] This protection was provided in the context of minimization the quantity of radioactive material in space and the risks involved.[51]

UN GA Resolution 68/74

United Nation General Assembly, on 11 December 2013 adopted the Recommendations on national legislation relevant to the peaceful exploration and use of outer space (UN GA Resolution 68/74). This Resolution included recommendations to consider. Among the eight proposed elements was the issue of the conditions for authorising space activities. The document indicates that the "conditions for authorization should help to ascertain that space activities are carried out in a safe manner and to minimize risks to persons, the environment or property and that those activities do not lead to harmful interference with other space activities; such conditions could also relate to the experience, expertise and technical qualifications of the applicant and could include safety and technical standards that are in line, in particular, with the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space".[52]

[49] A Soviet operational satellite (Cosmos 954), carried a nuclear reactor, fell on Canadian territory on 24 January 1978, spreading a huge amount of radioactivity over an area of 124,000 square kilometers.

[50] Hobe 2019: 109.

[51] Principle 3 of the UN GA Resolution 47/68: "In 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."

[52] Paragraph 4 of the UN GA Resolution 68/74.

UN GA Resolution 75/36

On 7 December 2020, the United Nation General Assembly adopted the Resolution reducing space threats through norms, rules and principles of responsible behaviours (UN GA Resolution 75/36). By UN GA Resolution 75/36, the General Assembly "encouraged Member States to study existing and potential threats and security risks to space system, including those arising from actions, activities or systems in outer space or on Earth, characterize actions and activities that could be considered responsible, irresponsible, or threatening and their potential impact on international security, and share their ideas on the further development and implementation of norms, rules and principles of responsible behaviors and on the reduction of the risks and misunderstanding and miscalculations with respect to outer space".[53]

Conclusion

As can be seen from the above, with regard to the classification of actions taken to ensure sustainable development, three levels can be indicated i.e. international activities (to which we can include for example the work of UNOOSA), the national level related to the enactment of relevant national policies (national space legislations on the example of Ukraine) and finally the contractual level covering industry and operators (for example the standard contracts of the ASI or DLR's policy). The issue of securing both the terrestrial and space environment, as with the insurance requirement, is mostly a necessary element for obtaining a space license.[54] The conditions that should be met when applying for authorisations for space activities should take into account minimising the risk to people, the environment and property, and should be conducted in a safe manner, not interfering with other activities in space.[55]

One can put forward the thesis that due to the obligation to authorise and supervise the space activities, it is the State's responsibility to take care of environmental protection. In general, treaty regimes oblige States to adopt appropriate legislation. Given these aspects, the adoption of a consensus on the regulation

[53] Paragraph 5 of the UN GA Resolution 75/36.
[54] Schildknecht 2022.
[55] UN GA Resolution 68/74.

of long-term sustainable development with a binding character seems to be a process that is too long and even impossible to achieve.[56] In order to adapt as quickly as possible to the changing space environment, it seems appropriate to apply international guidelines, which could be harmonised due to their diversity. On the other hand, however, the proposal to adopt a clear and precise definition of damage to the space environment could contribute to better identification of risks and better protection of outer space environment.

References

Agreement Governing the Activities of States on the Moon and Other Celestial Bodies adopted by the General Assembly in its resolution 34/68, opened for signature on 18 December 1979, entered into force on 11 July 1984.

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space adopted by the General Assembly in its resolution 2345 (XXII), opened for signature on 22 April 1968, entered into force on 3 December 1968.

Convention on International Liability for Damage Caused by Space Objects adopted by the General Assembly in its resolution 2777 (XXVI), opened for signature on 29 March 1972, entered into force on 1 September 1972.

Convention on Registration of Objects Launched into Outer Space adopted by the General Assembly in its resolution 3235 (XXIX), opened for signature on 14 January 1975, entered into force on 15 September 1976.

Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage ELD, 2004/35/WE.

ESA (2022a): *Space Debris by the Numbers.* Online: https://www.esa.int/Space_Safety/Space_Debris/Space_debris_by_the_numbers

ESA (2022b): *ESA's Annual Space Environment Report 2022.* Online: https://www.sdo.esoc.esa.int/environment_report/Space_Environment_Report_latest.pdf

European Commission (s. a.): *Environmental Liability.* Online: https://environment.ec.europa.eu/law-and-governance/compliance-assurance/environmental-liability_en

Federal Law No. (12) of 2019 Issued on 19/12/2019 Corresponding to 22 Rabi' Al-Akhar 1441H. On the Regulation of the Space Sector.

[56] NetZeroSpace 2022.

Guidelines for the Long-Term Sustainability of Outer Space Activities (Doc. A/AC. 105/2018/CRP.20).

Hobe, Stephan (2019): *Space Law.* Nomos Verlag.

Hofmann, Mahulena (2022): *Sustainability Aspects in the UN Space Treaties and the LTS Guidelines.* Online: https://npocspacelaw.univie.ac.at/fileadmin/user_upload/p_npocspacelaw/Sustainability_Mahulena_h.pdf

Lag om rymdverksamhet (Act on Space Activities 1982:963).

Laki avaruustoiminnasta (Finnish Act On Space Activities 63/2018).

Law of Ukraine of 15 November 1996 (VVRU, 1997).

Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales (1) (French Space Operations Act, No. 2008-518 2008).

Loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales (1) (French Space Operations Act, No. 2008-518 2008).

Loi portant sur les activités spatiales et modifiant: 1° la loi modifiée du 9 juillet 1937 sur l'impôt sur les assurances dite «Versicherungssteuergesetz»; 2° la loi modifiée du 4 décembre 1967 concernant l'impôt sur le revenue (Law of 15 December 2020 on Space Activities and amending: 1° the amended law of 9 July 1937 on the tax on insurance known as "Versicherungssteuergesetz" 2° the amended law of 4 December 1967 concerning income tax).

Loi relative aux activités de lancement, d'opération de vol ou de guidage d'objets Spatiaux (Law of 17 September 2005 on the Activities of Launching, Flight Operation or Guidance of Space Objects), Article 3.

Malinowska, Katarzyna – Kłoda, Mariusz Tomasz – Malinowski, Bartosz – Polkowska, Małgorzata – Hopej, Kaja – Szlachetko, Jakub (2022): *The Green Book of Polish Space Law.* Chapter 2. Definitions in Current Space Law (Comparative Analysis) and Proposed Solutions for Polish Space Law, Ad Astra. Astropolitics and Space Law Research Program, no. 4.

NASA (2021): *Nasa's Efforts to Mitigate the Risks Posed by Orbital Debris.* Office of Inspector General, Office of Audits. Online: https://oig.nasa.gov/docs/IG-21-011.pdf

NetZeroSpace (2022): Sustainable Outer Space by 2030: *Fostering Better and More Interoperable Norms: Recommendations for Enhanced Regulations and Public Policy with Regard to Space Debris Mitigation and Remediation Comparing Existing Binding National Requirements Relating to Space Debris.* Paris Peace Forum.

OECDiLibrary (s. a.): *Executive Summary. Accumulating Space Debris Puts the Sustainability of Space Activities at Risk.* Online: https://www.oecd-ilibrary.org/sites/16543990-en/index.html?itemId=/content/publication/16543990-en

Schildknecht, Thomas (2022): *Long-Term Sustainability of Outer Space Activities – International Guidelines.* Online: https://conference.sdo.esoc.esa.int/proceedings/ecsl19/paper/2/ECSL19-paper2.pdf?fbclid=IwAR2-OUNeQGQxbamIgIZN7YS-3LX6APaweCEakPmcNTQdBffS4Yj03nsYupzM

Stubbe, Peter (2017): Legal Consequences of the Pollution of Outer Space with Space Debris. In Read, Peter (ed.): *Oxford Research Encyclopedia of Planetary Science.* Oxford: Oxford University Press. Online: https://doi.org/10.1093/acrefore/9780190647926.013.68

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies adopted by the General Assembly in its resolution 2222 (XXI), opened for signature on 27 January 1967, entered into force on 10 October 1967.

UK Space Industry Regulations 2021.

United Nations General Assembly Resolution 47/68 Principles Relevant to the Use of Nuclear Power Sources in Outer Space, 1992.

United Nations General Assembly Resolution 68/74 Recommendations on national legislation relevant to the peaceful exploration and use of outer space, 2013.

United Nations General Assembly Resolution 75/36 Reducing space threats through norms, rules and principles of responsible behaviours, 2020.

UNOOSA (2021): *Compedium, Space Debris Mitigation Standards Adopted by States and International Organisations.* Online: https://www.unoosa.org/documents/pdf/spacelaw/sd/Space_Debris_Compendium_COPUOS_28_march_2022.pdf

UNOOSA (2022): *Space Debris Mitigation Standards.* Online: https://www.unoosa.org/documents/pdf/spacelaw/sd/Germany_2_20220222.pdf

О космической деятельности (Law of the Republic of Kazakhstan on Space Activities No. 528-IV of 6 January 2012).