»Guarding the cosmos«: exploring (non)existing legal frameworks for sustainable space activities

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ABSTRACT

The concept of sustainability in space may seem strange at first sight. After all, space is often seen as a vast, empty place without life and natural resources. However, our activities in space, including satellite deployment, space tourism and future plans for possible colonisation, pose potential risks to the delicate balance of this extraterrestrial environment. The legal framework for the sustainable implementation of space activities is examined in this article. A central chapter is devoted to the concept of sustainability and its extension to space, researching the existing legal regulation of space sustainability, or lack thereof. The link between the 2030 Agenda for Sustainable Development and space is also examined. The work analyses how the 2030 Agenda's goals of combating climate change, sustainable industry and sustainable resource management can be achieved through space technology. Finally, the legal and environmental aspects of space tourism are addressed. It explores how this form of space activity is (un) regulated and what are the environmental aspects that need to be taken into account. The aim of this work is to highlight the problem of the absence of binding legal regulation of the sustainable conduct of space activities and to point out that the adoption of appropriate legislation would be more akin to a natural evolution of the existing legal system than to a revolutionary change. Introducing the principles of sustainable development might offer a potential remedy for certain systemic issues within space law, especially concerning the safeguarding of outer space from space debris.

Keywords: space law, sustainable development, space activities, space debris, Agenda 2030, space tourism

»Varovanje vesolja«: analiza (ne)obstoječih pravnih okvirov za trajnostno izvajanje vesoljskih dejavnosti

POVZETEK

Koncept trajnosti v vesolju se morda na prvi pogled zdi nenavaden. Navsezadnje se vesolje pogosto obravnava kot ogromen, prazen prostor brez življenja in naravnih virov. Vendar pa naše dejavnosti v vesolju, vključno z nameščanjem satelitov, vesoljskim turizmom in prihodnjimi načrti za morebitno kolonizacijo, predstavljajo potencialna tveganja za občutljivo ravnovesje tega zunajzemeljskega okolja. V članku je obravnavana pravna ureditev trajnostnega izvajanja vesoljskih dejavnosti. Osrednje poglavje je namenjeno konceptu trajnosti ter njegovi razširitvi na vesolje, pri čemer se raziskuje obstoječo pravno ureditev trajnosti vesolja oziroma pomanjkanje le-te. Preučena je tudi povezava med Agendo 2030 za trajnostni razvoj in vesoljem. Članek predstavi, kako se lahko cilji Agende 2030, kot so boj proti podnebnim spremembam, trajnostna industrija in vzdržno upravljanje z viri, uresničijo s pomočjo vesoljske tehnologije. Nazadnje je obravnavan tudi pravni in okoljevarstveni vidik vesoljskega turizma. Raziskuje se, kako je ta oblika vesoljske dejavnosti (ne)urejena ter kakšni so okoljski vidiki, ki jih je treba upoštevati. Namen tega dela je izpostaviti problem odsotnosti zavezujoče pravne ureditve trajnostnega izvajanja vesoljskih dejavnosti in poudariti, da bi bilo sprejetje ustrezne zakonodaje bolj podobno naravnemu razvoju obstoječega pravnega sistema kot revolucionarni spremembi. Uvedba načel trajnostnega razvoja bi lahko ponudila potencialno rešitev za nekatera sistemska vprašanja v vesoljskem pravu, zlasti v zvezi z varovanjem vesolja pred vesoljskimi odpadki.

Ključne besede: vesoljsko pravo, trajnostni razvoj, vesoljske dejavnosti, vesoljski odpadki, Agenda 2030, vesoljski turizem

1. Introduction

On 4 October 1957, Soviet scientists launched the first artificial satellite, *Sputnik 1*, from the Baikonur Cosmodrome[1] into Earth

[1] Baikonur Cosmodrome is a space launch site in the desert steppes of Kazakhstan. It is one of the

orbit. The satellite became the first product of mankind to orbit the Earth, marking the official beginning of the Space Age (Lai, 2021, p. 8). The latter brought rapid advances in space technology and the exploration of space by humans and unmanned spacecraft. Over the past 60 years, the Space Age has produced some of the greatest scientific and technological advances in human history, from the landing of man on the Moon to the exploration of the outer reaches of our Solar System (Millbrooke, 2009, p. 1).

In the field of space law, the limitless vastness of outer space is combined with the complexity of legal frameworks. In an era of increasing exploration and exploitation beyond our planet, the need for rules and guidelines governing the sustainable use of outer space has become crucial. The concept of sustainability transcends earthly boundaries and includes the preservation of celestial environments, resources and the delicate balance of our interconnected universe.

As we head towards 2030, an important milestone marked by the 2030 Agenda for Sustainable Development on Earth, the space sector is inextricably intertwined with the global sustainability effort. From poverty eradication and environmental conservation to social equity and technological progress, the 2030 Agenda sets out a comprehensive roadmap to address humanity‘s pressing challenges.

In the vast expanse of outer space, one important area of interest is the developing field of space tourism. As private spaceflight gains prominence and offers civilians unparalleled opportunities to travel beyond the Earth‘s borders, the need for robust regulatory frameworks becomes apparent. Balancing safety, sustainability and equitable access to the space tourism experience is paramount in shaping this emerging industry.

The sustainable use of outer space is of paramount importance. The exploitation of space resources, space tourism and other space-related activities must comply with the principles of sustainability, ensuring long-term benefits for present and future generations. As humanity expands its presence beyond Earth, it is essential to strike a delicate balance between exploration and

oldest and largest space launch sites in the world and has been in operation since the late 1950s. It was originally built by the Soviet Union in response to the successful launch of Sputnik 1. The site was chosen because of its remoteness, flat terrain and proximity to the equator, which provides a natural boost for rockets launched from the site (Howell, 2018).

conservation, pioneering progress and protecting the integrity of celestial ecosystems. Space law, which is the legal basis for these efforts, has a crucial role to play in shaping the future of our space endeavours. It includes a range of legal principles, treaties and guidelines that govern the activities of States, organisations and individuals in outer space. Space law acts as a framework to ensure responsible behaviour, manage potential conflicts and protect the common interests of all humanity in outer space.

2. Space law essentials

International space law is defined as a branch of general (public) international law that covers the rules, rights and obligations of States relating to outer space and to activities in or relating to outer space (Von der Dunk, 2015, p. 29). Compared to other areas of law, space law is a relatively new area of law, the emergence of which is a process of new discoveries and achievements of mankind. International space law strives to secure the exploration and utilization of outer space in a manner that is peaceful, cooperative, and responsible (United Nations, 2023). Its goal is to advance the collective interests of all nations while ensuring the well-being of humanity as a whole.

The basic principles of space law are set out in five international treaties and agreements ratified by many States around the world. Together, they form the basis of modern space law, or *corpus juris spatialis* in the strict sense (Steer, 2017, p. 3). The Outer Space Treaty (hereafter »OST«) became effective on October 10, 1967, The Rescue Agreement, focusing on the rescue and return of astronauts and objects launched into outer space, took effect on December 3, 1968. Subsequently, The Liability Convention, addressing international liability for damage caused by space objects, came into force on September 1, 1972. The Registration Convention, focusing on the registration of objects launched into outer space, entered into force on September 15, 1976. Lastly, The Moon Agreement, governing state activities on the Moon and other celestial bodies, became effective on July 11, 1984 (Jankowitsch, 2015, p. 5).

But international space law is much more than these five instruments. It also encompasses the various conventions and

resolutions of the United Nations General Assembly, the rules, regulations and recommendations of international organisations, national laws that interact with the international system and, last but not least, »general international law« (Flis, 2018, p. 53). *Corpus juris spatialis* is therefore a term used in a broader sense to refer to a comprehensive legal framework that includes legal sources intended to regulate human activities in outer space (Steer, 2017, p. 3).

The United Nations Outer Space Treaties form a comprehensive global legal framework for regulating human activities in outer space. The pace at which states ratify these treaties may fluctuate, reflecting variations in adoption rates; however, their significance as the cornerstone of international space law remains indisputable (Von der Dunk, 2015, p. 29). Undoubtedly, these treaties constitute the primary legal foundation on the international stage, steering and overseeing a myriad of activities conducted in outer space. It's crucial to recognize that the evolving landscape of space exploration, technological advancements, and geopolitical dynamics underscores the enduring importance of these treaties (Von der Dunk, 2015, p. 29). As the linchpin of international space law, these agreements provide a foundational structure that not only addresses current challenges but also anticipates and adapts to the ever-changing nature of space activities. They serve as a testament to the collaborative efforts of nations to establish a coherent and universally applicable legal framework that transcends individual interests, fostering cooperation and responsible conduct in the exploration and use of outer space.

After the conclusion of the Moon Agreement, the progress of multilateral legislation through treaties under the United Nations (hereafter »UN«) experienced a significant slowdown, influenced by various factors (Jankowitsch, 2015, p. 6). In lieu of this slowdown, non-legally binding instruments meticulously crafted by Committee on the Peaceful Uses of Outer Space (hereafter »COPUOS«) and subsequently endorsed by the UN General Assembly have emerged as instrumental tools in fine-tuning the principles of space law. Good example are Guidelines for the Long-Term Sustainability of Outer Space Activities and Space Debris Mitigation Guidelines.[2]

[2] The LTS Guidelines developed by the United Nations, offer instructions for the sustainable oversight of space activities. This includes measures to prevent space debris and encourage collaboration

Furthermore, beyond the scope of COPUOS, an array of additional soft law instruments has emerged, significantly influencing the conduct of space actors. The diverse nature of these non-legally binding instruments adds a layer of flexibility, but it's noteworthy that their acknowledgment and adoption remain voluntary. However, this voluntariness doesn't diminish their impact; instead, it emphasizes the collaborative and cooperative nature of the international space community, allowing for a dynamic and adaptable framework that responds to the evolving challenges of space exploration and utilization (Palmroth et al., 2021, p. 3).

The growing adoption of non-binding guidelines and standards has sparked an increased commitment among nations to develop national space laws. These laws, extending beyond creating a binding framework for space activities within national borders, play a crucial role in bridging the gap between international and domestic legal systems and navigating the interface between legal obligations and soft law. The seamless integration of non-binding norms into national space laws transforms them into enforceable regulations within the jurisdiction of the state (Marboe, 2015, p. 128).

3. Sustainability beyond borders

The term »sustainability« has its origin in the Latin verb »*sustinere*«, with »*tenere*« meaning »to hold« and »*sus*« meaning »up«. Its essence lies in the ability to sustain an activity at a particular stage or level. Since the 1980s, this term has evolved beyond its original roots, expanding to encompass not only the capacity to maintain but also the responsible and enduring aspects of human habitation and the utilization of Earth and its resources. This evolution has culminated in the widely embraced concept of »sustainable development« (Martinez, 2015, p. 259). It is worth noting that the progression of the term reflects a growing global awareness of the interconnectedness between human activities, environmental well-being, and the responsible stewardship of natural resources. The adoption of »sustainable development« signifies a collective commitment to harmonizing societal progress with ecological

among stakeholders. On the other hand, the SDM Guidelines focus on tackling the problem of space debris. They provide guidance on the design, construction, and management of space objects to minimize collision risks and maintain long-term access to outer space.

integrity, acknowledging the imperative to strike a balance that ensures the well-being of present and future generations.

The idea of sustainable development hasn't been expressly applied to space. However, it's important to note that space has never been excluded from its consideration (Pogorzelska, 2013, p. 4). Interestingly, one of the principles in the Rio Declaration[3] emphasizes that states bear the responsibility of ensuring that activities within their jurisdiction or control do not result in environmental harm beyond national boundaries (Rio Declaration, 1992, Article 2).

According to Articles 1 and 2 of the OST, outer space is an area beyond national jurisdiction. It is part of the so-called »global commons« and its legal status is defined as »the domain of all mankind«, which cannot be subject to national appropriation (OST, 1967, Article 1 and 2). Two years following the Rio Declaration, the International Law Association explicitly stated that the responsibility to safeguard areas beyond national jurisdiction should be expanded to encompass Earth's orbital space (Pogorzelska, 2013, p. 3). This expansion of responsibility aligns with the dynamic nature of international law, adapting to the advancements and challenges posed by the ever-expanding realm of human activities, including those beyond our planet. Moreover, according to Article 3 of the OST, it is stipulated that States Parties are obligated to conduct activities related to the exploration and utilization of outer space in compliance with international law, including the UN Charter (OST, 1967, Article 3). This Article effectively incorporates the principles of space law into the broader framework of general international standards, of which sustainable development constitutes a vital component (Pogorzelska, 2013, p. 4). The recognition of sustainable development within the broader international standards reinforces the idea that responsible and ethical engagement in outer space activities should not only align with the specific principles of space law but also contribute to the overarching global goals of sustainability and harmonious coexistence.

So the idea of sustainable development isn't unfamiliar in the context of space regulations; instead, it appears to be a logical

[3] The Rio Declaration on Environment and Development, adopted at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992, consists of 27 principles that articulate the key elements of sustainable development.

progression of the system, more like a natural evolution than a radical transformation (Pogorzelska, 2013, p. 6). Interestingly, the OST anticipates the emergence of sustainability concepts. In Article 1, it asserts the freedom of outer space exploration for all nations on an equal basis, without any form of discrimination (OST, 1967, Article 1). This provision can be viewed as laying the groundwork for principles like intergenerational and intragenerational equality within space law. The emphasis on equal access to outer space, as enshrined in the OST, reflects a foundational commitment to fairness and cooperation among nations in the exploration of the cosmos. This equitable approach inherently aligns with the principles of sustainability, fostering a collective responsibility to ensure that the benefits and opportunities offered by space exploration are shared across generations. Therefore, the OST not only sets the stage for space law but also lays a solid foundation for integrating sustainable development principles into the fabric of international cooperation in outer space activities.

As both sustainable development and space law inherently prioritize human interests, their integration wouldn‘t usher in a drastic shift towards environmental-centric values. Rather, it implies that states should factor in environmental considerations when strategizing satellite launches or planning space missions (Viikari, 2008, p. 134).The essential tenets of sustainable development, such as the judicious use of natural resources, the amalgamation of environmental protection with economic progress, the right to development, and the pursuit of both intergenerational and intragenerational equity, can seamlessly align with the requisites of the space sector (Pogorzelska, 2013, p. 4). This alignment between sustainable development principles and space activities is not only pragmatic but also visionary. It recognizes the interconnectedness of human activities on Earth and in outer space and emphasizes the importance of responsible stewardship of resources. By integrating these principles, the space sector can contribute to a more holistic and balanced approach, ensuring that advancements in space exploration and utilization benefit not only the present generation but also future generations while safeguarding the delicate balance of our planetary ecosystem. This interconnected perspective reinforces the idea that responsible space endeavors can serve as a

model for sustainable and equitable development on a global scale.

Another compelling argument supporting the incorporation of sustainable development in outer space is its significant potential to tackle certain systemic challenges within space law regulation (Pogorzelska, 2013, p. 5). These challenges stem, in part, from the broad and ambiguous nature of space law norms concerning the safeguarding of outer space. A notable issue lies in the increasing disparity between regulation and the evolving reality of space activities. Without a revitalization of norms, this misalignment could impede the effectiveness of treaty instruments aimed at preserving outer space (Viikari, 2008, p. 134). Furthermore, within the treaty regimes, disagreements emerge. For instance, while the OST aims to facilitate the utilization of outer space, it overlooks the critical issue of space debris, posing a threat to the secure use of outer space (Pogorzelska, 2013, p. 5). It could be argued that the concept of sustainable development necessitates a reevaluation of norms with unsustainable consequences, urging their interpretation in alignment with the principles of sustainable development.

The sustainability of space activities faces an array of challenges that necessitate careful consideration and mitigation strategies. One key concern lies in the increasing congestion of Earth‘s orbit with satellites and space debris, posing risks of collisions and generating long-term environmental hazards. Effective space traffic management and debris mitigation efforts are imperative to ensure the long-term viability of space activities. Additionally, the rapid pace of technological advancements and the commercialization of space raise questions about resource utilization and exploitation. Striking a balance between economic interests and sustainable practices is crucial to prevent over-exploitation and the depletion of space resources. Furthermore, the environmental impacts of rocket launches and space exploration activities, including potential contamination of celestial bodies, demand comprehensive regulations and responsible practices (Viikari, 2008, p. 29).

Although the UN treaties governing outer space primarily focus on aspects like peaceful exploration and equitable resource sharing, they indirectly promote sustainability through fundamental principles. Despite the absence of an explicit reference

to sustainability and a formal definition within the UN treaties on outer space, it is crucial to acknowledge that these treaties do not neglect forward-looking environmental considerations. While sustainability may not be explicitly named, the principles embedded in the pursuit of utility, responsible behavior, and risk mitigation are essential foundations supporting the safe and sustainable use of outer space (Palmroth et al., 2021, p. 3). These principles not only align with the spirit of the UN Outer Space Treaties but also underscore a commitment to addressing evolving environmental challenges. Consequently, even without explicit terminology, the treaties lay a foundation for responsible and environmentally conscious conduct in space activities, contributing to the overarching goals of sustainability in the context of outer space exploration and utilization (Deva Prasad, 2019, p. 3).

A critical facet of space sustainability and the associated norms of responsible space behavior, extensively deliberated and regulated over the past two decades, primarily centers on the mitigation of space debris. Recognizing that an uncontrolled and uncoordinated surge in orbital debris could adversely affect the space activities of all stakeholders, whether governmental or private, established or emerging, has prompted the formulation of progressive regulatory measures (Palmroth et al., 2021, p. 4). Despite the primarily voluntary and technical nature of regulations targeting the reduction of space debris proliferation, numerous national legislators have not only embraced these rules but have also elevated them to mandatory conditions at the national level (Palmroth et al., 2021, p. 3). Recognizing that space activities inherently transcend national boundaries, the collaborative influence of international law, national regulations, and soft law is poised to uniquely contribute to the establishment of shared goals and ensure compliance among all space actors.

As the discussion around space sustainability continues to evolve, it becomes evident that responsible space behavior extends beyond the reduction of space debris. New challenges and opportunities arise, necessitating ongoing collaboration and adaptability in the legal and behavioral frameworks governing outer space activities. Issues such as resource utilization, space traffic management, and international cooperation in scientific exploration are gaining prominence, further emphasizing the need for a comprehensive and forward-looking approach to space law

that incorporates sustainability as a guiding principle for the benefit of all spacefaring nations.

4. Linking sustainability principles on earth with the cosmos

The 2030 Agenda and its 17 Sustainable Development Goals (hereafter »SDGs«) represent a transformative vision for a more sustainable and equitable future for our planet and its people. Achieving these ambitious goals requires innovative approaches and collaboration across sectors, and space technology is proving to be a powerful tool in this regard (Contribution to the »Space 2030« Agenda: EU Space Supporting a World of 8 Billion People, 2023, p. 29). In fact, space technology is an indispensable ally in achieving the SDGs, offering innovative solutions, comprehensive monitoring capabilities and global connectivity. By harnessing the power of satellites and space-based instruments, we can collect critical data, improve our understanding of complex challenges and implement targeted actions that contribute to sustainable development across multiple dimensions (Contribution to the »Space 2030« Agenda: EU Space Supporting a World of 8 Billion People, 2023, p. 30).

However, to ensure that space technology continues to be used for good and contributes to the 2030 Agenda, laws and regulations must be put in place that promote sustainable and responsible practices. Legislation should explicitly recognise and align with the SDGs. By incorporating the principles and goals of the 2030 Agenda into space-related laws, governments can create a legal framework that prioritises sustainable development, environmental protection and social well-being.

Space activities often involve multiple countries and stakeholders. Laws should promote international cooperation and collaboration and encourage the sharing of information, resources and expertise to jointly address global challenges. International agreements and guidelines, such as the OST and the SDGs, can provide a basis for collaborative efforts (Ferretti, Imhof, Balogh, 2020, p. 271). Legislation should also require transparency and accountability from space actors. This includes clear reporting mechanisms, disclosure of activities and their potential impacts, and mechanisms for stakeholder engagement. By promoting

transparency, governments and organisations can ensure that space technology is used responsibly and in line with the SDGs (Deva Prasad, 2019, p. 3).

It is also crucial that legislation contains provisions to manage and mitigate the environmental impact of space activities. This can include measures to reduce space debris, regulate satellite launches and operations, and promote sustainable use of resources. Environmental impact assessments and monitoring mechanisms can help identify and reduce potential environmental risks (Popova, Schaus, 2018, p. 6). It is also important that legislation supports ethical standards and ensures inclusiveness in space-related activities. It should address issues such as privacy, data protection and equitable access to space services. It should also promote diversity and equal opportunities in the space industry to ensure that the benefits of space technology are accessible to all.

Governments should establish or strengthen existing regulatory bodies to oversee space activities and ensure compliance with sustainable practices. These bodies can monitor compliance with laws, review applications for space missions and promote responsible behaviour by space actors. Collaboration between governments, industry, academia and civil society in the creation of these regulatory bodies can promote comprehensive and effective oversight (Di Pippo et al., 2021, p. 19). Laws and regulations governing space activities should be regularly reviewed and adapted to reflect technological advances, societal needs and changing environmental conditions. Regular evaluation ensures that the legal framework is up-to-date and responds to new challenges and opportunities (Contribution to the »Space 2030« Agenda: EU Space Supporting a World of 8 Billion People, 2023, p. 29).

By including these elements in legislation, governments can create an enabling environment that harnesses the potential of space technology for sustainable development. Legislation should provide clear guidance, promote responsible behaviour and ensure that space activities are in line with the 2030 Agenda, ultimately contributing to the achievement of the SDGs and improving society as a whole.

5. Space tourism's toll

Following the milestone of the inaugural »tourist« spaceflight in 2001, suborbital travel[4] has emerged as a novel dimension within commercial space activities. The rapid expansion of space tourism introduces unique legal challenges, demanding attention to ensure safety, accountability, and ethical practices in this dynamic industry. The current framework of space law, initially crafted for government-led exploration, proves inadequate in addressing the intricate legal issues associated with private space ventures (Von der Dunk, 2019, p. 178–179). As the momentum of space tourism accelerates, there arises a critical need to establish robust regulatory structures that skillfully navigate the delicate equilibrium between fostering innovation and safeguarding the broader public interest.

When space law was initially developed, the status of passengers on spacecraft did not pose any challenge, as only astronauts and cosmonauts participated in space flights and missions. Now, defining the legal status and rights of commercial space travelers, or tourists, becomes crucial. Ambiguity arises from using terms like »astronaut« and »spacecraft personnel« without clear definitions in international space law, as seen in treaties like the OST and Rescue Agreement (Hobe, 2007, p. 455.). Complicating matters, these terms vary in meaning across treaties. Stephan Hobe suggests a distinction, with »astronaut« reflecting a scientific role and »spacecraft personnel« having a functional meaning (Hobe, 2007, p. 455). This lack of clarity highlights the need for a nuanced approach in adapting space law to accommodate the commercialization of space activities.

The rapid technological strides in space tourism bring forth intricate legal dilemmas, with space vehicles embodying a hybrid nature, leveraging features from both conventional aircraft and spacecraft. These dual-purpose vehicles find themselves straddling the realms of both aviation and space laws, casting uncertainties on how to navigate registration and liability issues, par-

[4] Suborbital space tourism, exemplified by companies like Virgin Galactic, involves brief trips to the edge of space, providing passengers with a taste of weightlessness and stunning views of Earth's curvature. Moving into orbital space tourism, companies like SpaceX offer longer stays in Earth's orbit, allowing travelers to witness multiple orbits and experience extended weightlessness. Beyond these Earthly orbits lies the concept of tourism beyond Earth, envisioning interplanetary travel and stays in space habitats, including potential visits to the Moon or Mars.

ticularly concerning suborbital commercial space vehicles (Von der Dunk, 2019, p. 185). This quandary gains urgency as the production of two-part vehicles becomes a standard practice in the burgeoning field of space tourism. It's now paramount to shed light on these intricacies, emphasizing the pressing need to decipher the operational and legal complexities surrounding these cutting-edge vehicles. This evolving scenario underscores the necessity for regulatory frameworks to adeptly accommodate the distinct characteristics of the space tourism industry.

Engaging in space activities entails inherent risks and dangers. Thus, when delving into the legal aspects of space tourism, it becomes imperative to prioritize the intricacies and challenges within the existing liability framework outlined in the *corpus juris spatialis*. Since the 1963 UN Declaration on Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space, alongside the 1967 OST and the 1972 Liability Convention, liability regulation has stood as a pivotal component in governing outer space activities. However, the present liability structure, narrowly defined, falls short of accommodating the demands of the commercial advancements witnessed in the past two decades. Despite various provisions in current national and international regulations addressing liability for commercial space activities, persistent legal issues arise concerning the commercialization and privatization of space endeavors (Masson-Zwaan, Freeland, 2010, p. 1598). The existing liability regime has never been practically applied, leaving room for ongoing legal challenges, although the COSMOS 954 accident in 1978 almost set a precedent.[5]

As we delve into the realm of space tourism and its technological strides, it's imperative to scrutinize the potential environmental repercussions associated with this burgeoning industry. In the context of space law's philosophy of the »common heritage of mankind«, safeguarding the cosmic environment becomes paramount (Masson-Zwaan, Freeland, 2010, p. 1606). The upsurge in commercial space activities, notably space flights, significantly impacts the environment by harming the ozone layer and releasing pollutants like black carbon. Suborbital journeys, exemplified by Virgin Galactic, introduce black carbon into the atmosphere,

[5] COSMOS 954 was a Soviet satellite that had a nuclear reactor on board to power its systems. On 24 January 1978, the satellite suffered a critical malfunction which caused it to disintegrate and scatter its debris over a wide area, including the Canadian Arctic region (Byers, Boley, 2023, p. 64).

potentially altering global weather patterns (Byers, Boley, 2023, p. 38–41). While U.S. agencies have urged companies to study and mitigate their atmospheric impact, a more extensive international collaboration and commitment to sustainable practices are essential (McCue, 2022, p. 1097).

Beyond environmental concerns, ethical considerations emerge. Embarking on space tourism comes with a hefty price tag, making it an exclusive experience for a fortunate few. Critics contend that this exacerbates social disparities, sparking concerns about fairness and justice. The considerable financial and technological assets required for space tourism could instead be directed towards addressing urgent global issues like poverty, education, or climate change. Sooner or later, the status of important sites in space that are (and will be) historically significant will have to be regulated. Legislation will be needed to provide for »heritage zones« to protect certain sites, such as the site of the first manned lunar landing, from accidental or deliberate damage by space tourists (Masson-Zwaan, Freeland, 2010, p. 1606).

The current state of space law struggles to keep up with the dynamic landscape of the growing space tourism industry. It's seen as too inflexible to serve as a reliable foundation for space tourism. There's a pressing need for a fresh international convention solely dedicated to regulating commercial space tourism, aiming to clear up uncertainties in the field. Such a unified tool should consider and adopt elements from existing aviation law, treating it as a guiding model, especially when it comes to dealing with questions of liability. Establishing a comprehensive legal strategy is a key component in advancing the broader development of commercial aspects in space. This means that as we venture into economic activities in space, there should be a parallel implementation of a legal framework, overseen by an international body, to ensure robust support as a coherent system (Masson-Zwaan, Freeland, 2010, p. 1607).

6. The path forward

Space-age developments and innovations have led to a growing number of space actors, transforming a traditionally government-led industry into an increasingly commercialised one (Gaspari, Oliva, 2019, p. 188). The range of possible space applications

is expanding and the international community is becoming increasingly dependent on space activities. Space helps to improve the lives of people around the world and helps us to face the challenges of our time. Space imagery and data allow experts to develop strategies to combat climate change and reduce the damage caused by environmental disasters.

The issue of space debris and other challenges to the sustainability of outer space clearly shows that space activities, if carried out without proper legal and environmental considerations, can pose a major threat to humanity and the environment, and shows us that the international community must work towards a more effective and comprehensive legal regime that ensures and contributes to sustainability on Earth and in outer space.

Existing international space law addresses the sustainability of outer space indirectly and does not provide a comprehensive legal framework for the protection of the space environment, nor does it contain strict sustainability guidelines and principles on how to conduct space activities. The general obligations relating to the environmental aspects of space exploration and use found in UN treaties or principles need to be adapted to current scientific, technological and industrial developments.

The lack of adequate regulation for the sustainable implementation of space activities is like an ominous black hole that threatens the space environment, the implementation of the 2030 Agenda and future generations. While humanity is struggling to achieve sustainable development on Earth, a »Wild West« is unfolding in space without real rules. Space, which could be our partner in achieving the global goals, is becoming an arena for private space actors who indulge in a privileged experience at the expense of social inequality and environmental destruction.

It is time for the international community to come together and set clear guidelines to steer space activities in a direction that benefits all and ensures the long-term sustainability of our exploration and exploitation of space. Humanity deserves more than a chaotic space circus - it deserves a sustainable and responsible exploration of the unknown depths of space for the benefit of us all.

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