Journal of Ecohumanism
2025
Volume: 4, No: 2, pp. 178 – 193
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v4i2.5864

The Scope of National Sovereignty Over Outer Space and The Prevention of Environmental Hazards Arising from Its Exploration, Use, And Development

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Abstract

This study addresses issues related to the scope of national sovereignty, including the environmental dimensions related to the use and exploration of outer space. It highlights the environmental aspects related to outer space in the light of international treaties and relevant local laws. A series of results and recommendations were reached in this study, including : The absence of an international agreement on the boundaries of airspace and outer space requires the need to adopt solutions agreed upon by the international community (international treaties) so that the issue is treated as a legal issue rather than a scientific issue, emphasizing the importance of stating the obligations of States concerning the outer space environment. The use and exploration of outer space have led to the emergence of many environmental hazards and even environmental damage, such as space pollution, including orbital debris and radiation hazards, and the growth of some commercial activities harmful to the outer space environment, including the so-called space burial.

Keywords: *Administrative environmental control, environmental protection, limits of sovereignty, outer space, international environmental agreements.*

Introduction

The study sheds light on the environmental aspects related to outer space in light of international agreements and relevant national legislation and explores the boundary between outer space and airspace and the extension of sovereignty vertically, inspired by the international community to protect the environment and the United Nations 2030 Agenda for Sustainable Development.

The problem of the study:

This study focuses on the issue of determining the extent to which state sovereignty extends to environmental aspects in international law rules related to the use and exploration of outer space, taking into account that state sovereignty is not limited to the Earth's environment and its development, but extends to the protection of the environment of outer space and other planets, which requires highlighting the environmental issues associated with this.

Objectives of the study:

The objectives of this study are to address the extent to which state sovereignty covers the subject of environmental protection in outer space, identify the principles of outer space law that deal with environmental aspects, identify some of the environmental risks associated with the use and exploration of outer space, and identify some of the environmental risks associated with astronauts, equipment, and other elements of the environment that must be protected.

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Methodology of the study

The researcher relies on the descriptive method by studying the national and international legal rules under study, deriving solutions and drawing appropriate conclusions.

The researcher deals with this topic in two sections: The first section deals with the scope of state sovereignty and its impact on the concept of the environment in national legislation, and the second section deals with the use of outer space: The risks and environmental damage generated by the use of outer space and the rules governing them, as follows:

1. The Limits of State Sovereignty over Airspace and Its Vertical Extension to Include Outer Space

Sovereignty is the supreme attribute enjoyed by a state, whereby no external authority or state surpasses it, and no internal force equals it, encompassing independence externally and supremacy internally (Al-Shawi, 2013, p. 557). Without delving into the implications of the term "sovereignty" and the debates surrounding it, this study addresses the vertical scope of state sovereignty over its territory and the associated environmental risks.

Many Arab scholars in the fields of constitutional law and international law limit the definition of a state's territory to the area within which the state exercises the full authority granted by public international law. This includes the airspace above the land and water surfaces, extending up to the layers of the atmosphere where outer space begins (Sabbarini, 2007, pp. 105-106), without entering into the problematic relationship between airspace and outer space. Thus, scholars commonly use the term "air territory," which frequently appears in constitutional and administrative law texts. One researcher noted that air territory refers to the atmospheric layers above a state's land and water territories without specifying a particular altitude (Layla, 1969, p. 31), even though the term "air" or "airspace" has a specific connotation related to air law and is distinct from space law. Meanwhile, some scholars have acknowledged the controversy surrounding the altitude of airspace and its inclusion of outer space. Nevertheless, they have confined the definition of air territory to the airspace above the land and maritime territories, where the state exercises its sovereignty over this portion of the territory without specifying a particular altitude (Al-Khatib, 2004, p. 25).

This necessitates addressing the issue of the limits of state sovereignty over airspace and its extension into outer space, as follows:

1.1. The Extent of State Sovereignty over the Airspace Above It

The issue of state sovereignty over airspace has been the subject of various jurisprudential theories, with some supporting and others opposing such sovereignty. One theory rejected state sovereignty, drawing an analogy to the legal status of the high seas, arguing that effective control over airspace is impossible and emphasizing the international community's interest in enhancing communication and trade among its members. This led to the principle of the freedom of the air (Al-Hashemi, 2009, pp. 27-28). Among the proponents of this view was the jurist (Faucher), who argued that sovereignty is a real bond between the sovereign owner and the sovereign subject, and it is the inevitable result of legal and material control or a natural legal consequence of such dual control (Al-Sabbagh, 2019, p. 1052). On the other hand, another theory took the opposite stance, affirming state sovereignty over the airspace above it. It argued that the international community's interest in air navigation makes this sovereignty restricted rather than absolute, advocating for the right of innocent passage for aircraft without compromising the interests of the territorial state (Al-Hashemi, 2009, pp. 29-31). Meanwhile, a conciliatory approach (theories of air zones) sought to reconcile the two previous views by dividing airspace into several zones, drawing an analogy to the legal status of maritime zones. Among the most prominent theories under this approach is the one that divides airspace into three zones: a lower zone connected to the state's territory and fully subject to its sovereignty, a middle adjacent zone where the state exercises certain aspects of sovereignty to ensure that aircraft are not used in a way that harms its interests while guaranteeing the right of innocent passage, and an upper zone where air navigation is free for all states, analogous to the high seas (Hamdallah, 2016, pp. 26-27).

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However, the legal status of airspace is based on the principle of state sovereignty over its airspace, limited by the right of innocent passage. The Chicago Convention on International Civil Aviation of 1944 and its amendments, in Article 1, affirmed the complete and exclusive sovereignty of states over the airspace above their territories (Chicago Convention on International Civil Aviation, 1944). This reiterated what was stated in Article 1 of the Paris Convention Relating to the Regulation of Aerial Navigation (1919). However, the Chicago Convention distinguished itself by revealing this as an inherent right of all states, not just the parties to the convention. Moreover, the concept of sovereignty contained in the convention is not absolute but is subject to numerous restrictions mentioned in the convention, including those in Article 5, which expanded beyond the right of innocent passage to include the principle of the Five Freedoms (Adour, 2021, pp. 266-267). These freedoms include: (1) the privilege to fly over the territory of other parties without landing; (2) the privilege to land for non-traffic purposes; (3) the privilege to disembark passengers, mail, and cargo carried by the aircraft in the territory of the state of the aircraft's nationality; (4) the privilege to transport passengers, mail, and cargo destined for the territory of the state of the aircraft's nationality; and (5) the privilege to transport passengers, mail, and cargo destined for the territory of any other party and to disembark passengers, mail, and cargo coming from any such territory (Cassel, 1971).

Additionally, Article (6) of the Chicago Convention states: "No scheduled international air service may be operated over or into the territory of a contracting state except with the special permission or other authorization of that state and in accordance with the terms of such permission or authorization." Similarly, Article (9) grants states the right to "prohibit or restrict uniformly the aircraft of other states from flying over certain areas of its territory for reasons of military necessity or public safety... to prohibit or restrict temporarily and immediately flight over its territory or part thereof due to exceptional circumstances, during a crisis, or for reasons of public safety" (Chicago Convention on International Civil Aviation, 1944).

Although the convention uses the term sovereignty over airspace, it primarily refers to aircraft and does not imply that outer space is included. Nor does it mean that a state's sovereignty over the airspace above it is unlimited and absolute. The airspace of a state has a unique character that differs from its sovereignty over land or water territories, particularly due to the fluidity of its contents. Moreover, the layers of air above a state's airspace are constantly changing due to the Earth's rotation, making it impossible for a state to define the boundaries of its airspace in a fixed manner. Nevertheless, there are serious risks related to national security.

According to Article 1 of the UAE Federal Civil Aviation Law, an aircraft is defined as any machine that derives its ability to remain in the air from the reaction of the air not reflected from the Earth's surface. This includes all aerial vehicles such as balloons, fixed-wing and rotary-wing aircraft, and others, provided they are designated for civil purposes (Federal Civil Aviation Law No. 20 of 1991). This definition aligns with that of the International Civil Aviation Organization (ICAO) as outlined in Chapter 1 of Annex 13 to the Chicago Convention (International Civil Aviation Organization, 2024). The UAE legislator used the term "airspace" in Article 20, indicating that the law applies within the scope of civil aviation for aircraft that derive their ability to remain in the air from the reaction of the air. In other words, the legislator is referring to the layers of the atmosphere where air exists.

Similarly, the Jordanian legislator, in Article 2 of the Civil Aviation Law No. 41 of 2007 and its amendments, closely followed the UAE's definition of an aircraft but provided more examples without restricting them to a specific purpose. The definition includes "all aerial vehicles such as balloons, airships, helicopters, gliders, fixed-wing aircraft, drones, or remotely piloted vehicles."

However, the airspace under this law does not extend to outer space, even though Articles 6-8 of the UAE Civil Aviation Law refer to the "territory of the state and the space above it" without specifying a particular altitude at which state sovereignty ends. This raises questions when read alongside Article 1, which defines the state's territory to include land, water, and the airspace above it. Did the legislator create confusion by using the phrase "territory of the state and the space above it," especially since the term "state territory" under Article 1 of the law includes the space above it? Or did the UAE legislator intend for sovereignty to extend beyond what it termed "airspace" in Article 1 to include space in general?

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Naturally, it can only be concluded that the legislator created ambiguity in Articles 6-8, particularly in light of the definition of an aircraft, which includes air as a key element. Since this law revolves around the concept of aviation, it can be confidently stated that it does not include outer space. Another piece of evidence can be drawn from the UAE legislator's approach to the maritime territory, where the maritime zones are defined in detail and realistically in Federal Law No. 19 of 1993 concerning the Determination of Maritime Zones. What can be practically subjected to sovereignty is defined realistically, and it cannot be said that sovereignty over airspace extends to include outer space. This is further supported by the Federal Decree-Law on the Space Sector.

The Federal Decree-Law on the Regulation of the Space Sector provides a precise definition of the state's territory, which includes "the land of the state, its territorial sea, and the airspace above them, including free zones or any areas with a special economic status." This means that the UAE legislature distinguished between airspace and outer space and did not include outer space in the definition of the state's territory. Outer space is defined as "any area 80 kilometers or more above the mean sea level." However, this does not mean that the state has relinquished its rights in the field of investment and exploitation of outer space, as evidenced by the provisions of Articles 2-4, which outline the objectives, scope of application, and activities subject to this Decree-Law (Federal Decree-Law No. 46 of 2023 concerning the Regulation of the Space Sector, 2024).

Given the connection between investment and exploration in outer space and the economic aspect of the state, as well as its capacity to venture into this field, Jordanian legislation has not regulated this issue and has limited itself to regulating airspace. Although the term "airspace" is used twice in Article 27 of the Civil Aviation Law No. 41 of 2007 and its amendments, the law does not define "airspace" in Article 2. Instead, it uses the term "air domain," which includes: "any space over the land or territorial waters of the Kingdom within which air traffic control services, flight information, and search and rescue alerts are provided by the competent authorities in accordance with international and national standards and recommended practices." Article 3 affirms the full and exclusive sovereignty over the air domain above the territory of the Kingdom.

In light of this, the researcher recommends that the Jordanian legislator replace the term "airspace" with "air domain" in the next amendment to Article 27 of the law to ensure consistency and coherence in the terminology used and to align with Article 2 of the same law.

1.2. The Vertical Sovereignty of States over Their Territory and Its Extension to Include Outer Space

The determination of a clear boundary separating outer space from airspace, which falls within the scope of state sovereignty, remains a contentious issue and forms the basis for its legal definition. Although the Outer Space Treaty of 1967, in its Article II, prohibits the national appropriation of outer space, whether by claim of sovereignty, use, occupation, or any other means and obligates states in Article IV to refrain from placing nuclear weapons or other weapons of mass destruction in orbit around the Earth or on celestial bodies, the question of the boundaries of outer space remains unresolved. Various opinions have emerged on this matter, including those concerning the upper limit of the atmosphere, the extent of Earth's gravitational influence, the boundary between aviation and space navigation, and the maximum area over which a state can exercise effective control, among others (Engvers, 2001, p. 17).

Despite the launch of numerous satellites and other objects into orbits around the Earth, no state has objected to their passage over its territory as a violation of sovereignty. Similarly, no state has attempted to define its airspace within a specific altitude (Barrett, 1973). However, we disagree with this reasoning, as silence cannot be interpreted as consent or the emergence of customary international law, especially concerning the use of geostationary orbits (GSO) by placing satellites over specific countries or the pollution of outer space with debris.

Although the Moon Agreement of 1979 was the first to explicitly state in Article 11 that the Moon and its natural resources are the "common heritage of mankind," prohibiting national appropriation by any means, and declaring that the Moon and its resources cannot become the property of any state, international

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organization, or individual, the question of outer space boundaries remains unresolved (United Nations, 2008, p. 36). This opens the door to treating outer space and its components as a common heritage of mankind.

The difference between the legal regime governing the airspace, represented by air law based on state sovereignty, and the legal regime governing outer space, which forms the core of international space law and is based on the benefit of the international community and the prohibition of sovereignty claims, has sparked debate over the extent of national sovereignty in outer space and the boundaries between national sovereignty and "outer space." In other words, the vertical limits and constraints on national sovereignty remain unsettled. Since there are no agreed-upon boundaries between national territories and free space, the vertical boundaries of national sovereignty are generally unstable. Some scholars argue that it is up to each state to define the vertical limits of its sovereignty (Reinhardt, 2007, p. 66). However, this does not negate the importance of understanding the efforts made to define the boundary between airspace and outer space, given the differing legal regimes for each.

One opinion suggests that sovereignty extends infinitely, as the higher one goes, the greater the potential damage from falling objects. While there are limits to state sovereignty over maritime territory, there is no such limit for airspace, which remains under state sovereignty regardless of distance (Reinhardt, 2007, p. 71). This view, based on an ancient Roman law principle that property rights extend to the depths of the Earth and the heights above it (Moon, 1963, p. 329), has been abandoned due to the difficulties it poses (Al-Majdoub, 2018, p. 524). This opinion lacks precision, as any claim to infinite territorial sovereignty in space would not only violate international law but also conflict with fundamental astronomical facts, such as the Earth's rotation, which means its position relative to space and celestial bodies is never fixed (Oduntan, p. 78).

Scientific indicators in this field rely on the division of atmospheric layers to define the boundary between airspace and outer space. These layers include the troposphere, the densest layer where most weather phenomena occur, extending from the Earth's surface to an altitude of 7 to 15 kilometers (5 to 10 miles). The troposphere is thicker at the equator and thinner at the poles. As altitude increases, air density and temperature decrease. At the upper limits of this layer, strong winds known as jet streams are crucial for aviation, as flying at this altitude with these winds saves time and costs compared to lower altitudes where the air is denser (National Geographic, 2024). Another layer is the thermosphere, which begins at 85 kilometers (53 miles) above sea level and extends to 690 kilometers (429 miles). This thin layer contains light gases such as oxygen and helium (Atmosphere, 2024). In this layer, the Hubble Space Telescope, the International Space Station (ISS), and satellites in low Earth orbit (LEO) operate (McFadden, 2022).

Some scholars have attempted to define the beginning of outer space based on the content of the atmospheric layer (e.g., the absence of atmosphere and the presence of a vacuum) at an altitude of 50 miles above sea level, as the U.S. Air Force and NASA award astronaut badge to pilots who fly above this altitude. This is based on the theory of aerodynamic lift, which states that the movement of aircraft in airspace at a constant altitude must consider the balance between weight, centrifugal force, and aerodynamic lift. As altitude increases, air density and pressure decrease, and above 83 kilometers, aerodynamic lift vanishes, leaving the object or vehicle under the influence of centrifugal force. This led scholars like Haley and Hogan to argue that airspace ends where aerodynamic lift ceases, in the stratosphere. Thus, the scientific and legal consensus is that 25 miles (40 kilometers) above sea level is the maximum practical altitude for aircraft requiring aerodynamic support, and at 53 miles (85 kilometers), an object traveling at 25,000 feet per second (approximately 8 kilometers) will be under centrifugal force control. This is known as the Kármán line, representing the highest altitude at which sovereignty can be imposed. The logic of this approach is that airspace sovereignty in air law pertains to the regulation of aircraft and other flying vehicles that require aerodynamic lift. Once the aerodynamic features that provide "lift" to conventional aircraft vanish, state sovereignty and jurisdiction cease, allowing for a boundary based on aerodynamic characteristics to separate airspace from outer space (Oduntan, pp. 72-73).

Oduntan advocates for a compromise division of the space above a state's territory for purely legal purposes, independent of scientific considerations. This division includes three zones:

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(a) A demarcation line representing the lower limit of territorial airspace at approximately 55 miles, considered the maximum altitude for airspace under full and exclusive state sovereignty.

(b) A buffer zone of 45 miles, recognized as a zone of innocent passage for all states.

(c) A demarcation line for the beginning of outer space at 100 miles, representing the start of outer space, free from all claims of legal sovereignty and jurisdiction (Oduntan, p. 82).

When considering solutions to distinguish between airspace and outer space, the outer limit of the atmosphere may be a plausible option. The Chicago Convention hinted at this solution by using the terms "air," "airspace," and "atmosphere" in Annex 13. However, the atmosphere does not end abruptly but gradually, and there is no scientific consensus on the altitude at which it ends (Barrett, 1973, p. 36). If the boundary is considered to start at the point where a satellite can be placed in a stable orbit around the Earth, it would begin at 80 miles (approximately 129 kilometers). It is worth noting that there is no final resolution on this matter (Jimmerson, 2003, p. 13).

Some countries have adopted the Kármán line (100 kilometers) as the boundary for outer space. For example, Article 8 of Australia's Space (Launches and Returns) Act defines a "space object" as any object or part thereof intended to reach or return from an area beyond 100 kilometers above sea level (Space (Launches and Returns) Act 2018, 2023). Similarly, the UAE legislator, in the Federal Decree-Law on the Regulation of the Space Sector, defined the state's territory to include "the land of the state, its territorial sea, and the airspace above them, including free zones or any areas with a special economic status." Outer space was not included in this definition but was separately defined as "any area 80 kilometers or more above mean sea level." However, this does not mean the state has relinquished its rights under international law related to outer space, as evidenced by Articles 2-4, which outline the objectives, scope, and activities governed by this Decree-Law.

It is incorrect to claim that Ecuador has set a vertical sovereignty limit of 36,000 kilometers above its territory (Neto, 2012, p. 30). Referring to Article 4 of Chapter I (Fundamental Principles) of the Ecuadorian Constitution, it is clear that Ecuador asserts its rights over the geostationary orbit, maritime territory, and Antarctica, but this does not equate to full sovereignty (Ecuador National Assembly, 2008). Ecuador's claim to rights over the geostationary orbit stems from its position on the equator. At an altitude of 42,164 kilometers above the Earth's center (or 36,000 kilometers above the surface), a satellite's orbit matches the Earth's rotation, allowing it to remain fixed over a specific longitude. This is particularly important for weather monitoring, communications, and other purposes (NASA, 2009). Ecuador's stance is justified, as it is one of the equatorial countries that signed the Bogotá Declaration (1976), which asserts that the geostationary orbit is a physical reality linked to Earth's gravity and a natural resource subject to the sovereignty of equatorial states. The parts of the orbit over international waters are considered the common heritage of mankind, to be regulated by international agencies for the benefit of humanity (Declaration of the First Meeting of Equatorial Countries, 1976).

It is difficult to agree with the view that there is no need to define a boundary between airspace and outer space, given the lack of protests by states over the passage of satellites or spacecraft over their territories. Silence in this context does not imply consent but may indicate acceptance of the right of innocent passage in that domain. Moreover, defining a boundary would not hinder technological progress or space exploration but could positively contribute to the advancement and development of space technology (Oduntan, pp. 68-69).

The lack of consensus among scholars and states on the vertical limits of sovereignty is evident in the report presented to the Committee on the Peaceful Uses of Outer Space during its 62nd session in 2023. The report reflected a wide range of opinions, with some states supporting the definition of a boundary as a priority to reduce uncertainty, mitigate risks to space activities, and prevent potential conflicts between states. Within this view, opinions varied on whether the boundary should be set between 100 and 110 kilometers above sea level, based on comprehensive considerations including atmospheric layers, the maximum altitude of aircraft, the Kármán line, and the perigee of spacecraft in orbit. Others argued that

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the boundary should be based on the geostationary orbit, a limited natural resource that should not be subject to national appropriation. Conversely, some argued that defining a boundary is unnecessary, could complicate existing activities, and may not align with ongoing technological developments (United Nations: Committee on the Peaceful Uses of Outer Space, 2023, pp. 14-16).

In light of the lack of international agreement on a clear boundary between airspace and outer space, despite its importance given the differing scientific and practical indicators, the researcher agrees with the recommendation made by scholar Neto that the international community should adopt a consensual legal solution to address this issue, treating it more as a legal matter than a scientific problem (Neto, 2012, p. 30).

2. Environmental Risks Associated with Outer Space and the Legal Framework Regulating Them

The term "environment" encompasses the surroundings in which various forms of life, organisms, and materials exist, as well as the surrounding milieu (Jordanian Environmental Protection Law, 2017). This environment consists of two elements: a natural element, which includes living organisms and natural resources such as soil, water, air, natural systems, and organic and inorganic materials, and an artificial element (human-made environment), which encompasses human interventions in nature, including transportation, infrastructure, industries, innovations, and technologies (Federal Law on the Protection and Development of the Environment and its Amendments, No. 24 of 1999). Despite the generality of these definitions in both legislations, they do not extend to include outer space.

It can be argued that space exploration is an environmentally polluting industry in various ways. The development of space technology and the transportation of its products to Earth are far from being environmentally friendly activities. The launch phase, in particular, produces noise, pollution, dust, and emissions. A recent example of the harmful effects of launch activities is a study indicating that launches from the Russian space base in Kazakhstan cause serious health problems among people living under the flight path of rockets. For instance, the levels of endocrine diseases and blood disorders in children are more than double the regional average. This is attributed to the highly toxic propellants (especially hydrazine) that are released onto the ground along the flight paths. According to a rough estimate, quantities of unburned fuel are dumped over several square kilometers of land with each launch (Viikari, 2008, p. 29).

Environmental risks also extend to radiation hazards affecting both the space environment and the Earth's environment, including orbital debris. New environmental risks and damages have emerged, such as the use of satellites to harness solar energy. Although these satellites have advantages due to their location in space, which allows them to continuously receive solar energy, their immunity to weather conditions and the alternation of day and night, and their relatively small size compared to terrestrial solar projects, their use can harm the environment, negatively affect the ozone layer and air navigation, and potentially impact various elements of both the space and terrestrial environments (Viikari, 2008, pp. 48-54).

Other risks include the growth of activities harmful to the outer space environment, whether for space tourism, scientific exploration, or commercial purposes. One such activity is space burial, which involves sending a portion of cremated remains or DNA of the deceased into space to orbit the Earth and then fall as a shooting star at a predetermined time, be released into space, or sent to the Moon or farther into space (Celestis, Inc, 1994-2024). Additionally, several exploratory space missions have negatively impacted the environments of other planets. For example, the Lunar Prospector spacecraft ended its mission on July 31, 1999, with an intentional crash near the Moon's south pole. The goal was to release water vapor from suspected ice deposits in that region, with the vapor plume detectable from Earth. However, the crash did not achieve its objective of confirming the presence of water on the Moon (National Aeronautics and Space Administration - NASA, 2022). This necessitates a discussion of the environmental aspects in international agreements and the work of the United Nations.

2.1. The Environmental Dimension in International Agreements Regulating Outer Space

In 1963, the United Nations General Assembly adopted the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (the 1963 Declaration), the first international

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instrument to provide a set of guidelines for regulating states' space activities. This was followed by five treaties collectively referred to as the "core of international space law," which include: the Outer Space Treaty (OST, 1967); the Rescue Agreement (1968); the Liability Convention (LIAB, 1972); the Registration Convention (1975); and the Moon Agreement (1979). These treaties address various aspects of the outer space environment, as outlined below in chronological order:

2.1.1. The Outer Space Treaty (1967)

As of early 2024, the treaty has 114 member states (through succession, ratification, approval, acceptance, or accession) (Committee on the Peaceful Uses of Outer Space, 15 April 2024, p. 10).

The 1963 Declaration is reflected in the treaty's Articles I, II, III, V, and VI, which enshrine principles such as the freedom of exploration and use of outer space, the prohibition of national appropriation, and the application of international law, including the UN Charter, to space activities. Article IV incorporates General Assembly Resolution 1884 (XVII) of 17 October 1963, calling on states to refrain from placing nuclear weapons or other weapons of mass destruction in orbit or in outer space (United Nations Treaties and Principles on Outer Space, 2008, pp. 3-9).

Articles I and II complement each other: Article I links the exploration and use of outer space to the benefit of all humanity, emphasizing freedom of exploration and use based on equality and non-discrimination. Article II reinforces this by prohibiting national appropriation of outer space.

Article III requires states to conduct their activities in accordance with international law, including the UN Charter, to promote international cooperation and maintain peace and security. Article V highlights the importance of protecting astronauts as "envoys of mankind," requiring states to provide assistance in case of accidents or emergency landings and to promptly inform other states or the UN Secretary-General of any phenomena that could endanger astronauts' lives or health.

Article VI establishes international responsibility for national activities in outer space, whether carried out by governmental or non-governmental entities and mandates continuous supervision of non-governmental activities. Article VII extends liability to damage caused by space objects, whether on Earth, in airspace, or in outer space, holding the launching state absolutely liable for such damage.

Article IX forms the basis for environmental protection in outer space, requiring states to avoid harmful contamination and adverse changes to the Earth's environment caused by the introduction of extraterrestrial matter. However, the treaty does not define "harmful contamination" or distinguish it from non-harmful contamination.

2.1.2.The Rescue Agreement (1968)

This agreement has 100 member states as of early 2024 (Committee on the Peaceful Uses of Outer Space, 15 April 2024, p. 10).

The agreement builds on Article V of the Outer Space Treaty, emphasizing cooperation in protecting astronauts as part of the space environment. States are obligated to promptly notify the launching state and the UN Secretary-General if astronauts land in their territory, on the high seas, or in areas beyond any state's jurisdiction, and to take all possible measures to rescue and assist them (United Nations Treaties and Principles on Outer Space, 2008).

While the agreement does not explicitly require states to inform each other of phenomena that endanger astronauts' lives or health, as stated in Article V of the Outer Space Treaty, its use of the phrase "any other place not under the jurisdiction of any state" is broad enough to include outer space.

2.1.3.The Liability Convention (1972)

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This convention has 100 member states as of early 2024 (Committee on the Peaceful Uses of Outer Space, 15 April 2024, p. 10).

Article II establishes the liability of the launching state for damage caused by its space objects on Earth or to aircraft in flight. "Damage" includes loss of life, personal injury, or damage to property, whether of states, natural or juridical persons, or international organizations. If damage is caused to a space object of another state or to persons or property on board, the launching state is liable only if the damage is due to its fault or the fault of persons for whom it is responsible. Article XII ensures that compensation restores the injured party to its pre-damage condition (LIAB, 1972).

Article XXI addresses situations where damage poses a large-scale risk to human life or disrupts the living conditions or vital centers of a state, requiring launching states to consider providing urgent assistance to the affected state upon request, without prejudice to other liability rules.

2.1.4. The Registration Convention (1975)

This convention has 75 member states as of early 2024 (Committee on the Peaceful Uses of Outer Space, 15 April 2024, p. 10).

The convention complements previous space treaties by requiring launching states to register space objects launched into Earth orbit or beyond and to inform the UN Secretary-General of the establishment of such a register (Registration Convention, 1975).

Article VI addresses situations where a state cannot identify a space object that has caused damage or poses a hazard, requiring other states, particularly those with space tracking facilities, to assist in identifying the object under fair and reasonable terms. The requesting state must provide information about the time, nature, and circumstances of the event leading to the request.

2.1. 5. The Moon Agreement (1979)

This agreement has the lowest acceptance, with only 17 member states as of early 2024 (Committee on the Peaceful Uses of Outer Space, 15 April 2024, p. 10).

The agreement emphasizes the importance of environmental protection in its preamble and Articles 1 and 2, which apply to the Moon and other celestial bodies within the solar system, excluding materials that reach Earth naturally, such as meteorites. Article 3 requires states to conduct their activities in accordance with international law, including the UN Charter, and to promote international cooperation and mutual understanding.

Articles 3 and 11 establish key principles, including:

- The exclusive use of the Moon for peaceful purposes and the prohibition of military activities, weapons testing, and the establishment of military bases.
- The designation of the Moon and its natural resources as the "common heritage of mankind," prohibiting national appropriation and ensuring equitable sharing of benefits.
- The obligation to establish an international regime to regulate the exploitation of the Moon's natural resources when such exploitation becomes feasible.

The Convention, in Article (7), emphasized the enhancement of the commitment of the States Parties towards the lunar environment by necessitating the adoption of measures to ensure the prevention of the disruption of the balance of the lunar environment, whether by causing harmful changes to it, or by polluting it in a harmful manner through the introduction of foreign substances to its environment or by other means, as well as taking the necessary measures to prevent the harmful impact on the Earth's

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DOI: https://doi.org/10.62754/joe.v4i2.5864

environment by the introduction of extraterrestrial substances, and the necessity of notifying the Secretary-General of the United Nations of those measures taken in advance, and informing him of any radioactive materials and objects placed on the Moon. Furthermore, Article (10) addressed the duty to take all practical measures to protect the life and health of persons on the Moon and to consider any person present on the Moon as an astronaut for the purposes of applying Article V of the Outer Space Treaty. What distinguishes this Convention is the affirmation in Article (11) that the Moon and its resources are the common heritage of mankind, so that it shall not be subject to national appropriation, nor shall the surface of the Moon, or what lies beneath it, or any part thereof, become the property of any state, or any organization, entity, or natural person (Moon Agreement, 1979).

2.2. UN Resolutions, Declarations, and Principles with Environmental Relevance:

The United Nations (UN) has played a pivotal role in addressing global environmental challenges through various resolutions, declarations, and principles. These instruments provide frameworks for international cooperation, set standards for environmental protection, and promote sustainable development. Below is a list of key UN resolutions, declarations, and principles with environmental relevance:

2.2.1. Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space (1963)

This declaration includes the following: Stipulating that the exploration and use of outer space shall be carried out for the benefit of all humanity, the freedom of exploration on an equal basis and in accordance with international law, the non-appropriation of outer space and celestial bodies by national claims, and international responsibility for national activities in outer space, whether carried out by governmental agencies or non-governmental entities (United Nations General Assembly, Resolution 1962 (18th Session)).

These principles were enshrined in the aforementioned space-related agreements, starting with the Outer Space Treaty and extending to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies.

2.2.2. Principles Relating to Remote Sensing of the Earth from Outer Space (1986)

Remote sensing is defined as the use of the properties of electromagnetic waves reflected, emitted, or diffracted by sensed objects for the purpose of observing the Earth's surface from space, with the aim of land utilization, improving the management of natural resources, and protecting the environment. Among the most important principles included in these guidelines are:

- Principle Ten, concerning the enhancement of the protection of the Earth's natural environment, which stipulates that States participating in remote sensing activities—when they obtain information that could help avoid any phenomenon harmful to the Earth's natural environment—shall make such information available to the concerned States.

- Principle Eleven, which emphasized the role of remote sensing activities in enhancing the protection of humanity from disasters. It requires States participating in remote sensing activities that possess information that could benefit States affected by natural disasters or potentially affected by imminent natural disasters to transmit such data to the concerned States as promptly as possible.(United Nations Treaties and Principles on Outer Space, 2008)

2.2.3. Principles on the Use of Nuclear Power Sources in Outer Space

The use of nuclear power sources, whether during launch phases or more broadly, entails risks that threaten the Earth's environment and outer space. Therefore, the United Nations General Assembly Resolution No. 47/68 addressed this issue through a set of principles. According to Principle Three, the use of such sources in outer space should be restricted to space missions that cannot reasonably be carried out using other energy sources. The resolution included a set of guidelines and standards for safe use (The UN General Assembly Resolution No. 47/68, 1992):

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a) States launching space objects carrying nuclear power sources are obligated to ensure the protection of individuals, communities, and the biosphere from radiation hazards. The design and use of such objects must ensure that foreseeable risks are minimized and that radioactive materials do not cause significant contamination of outer space. Adequate radiation protection for the public must be observed in accordance with the recommendations of the International Commission on Radiological Protection. Additionally, there must be no significant radiation exposure during the normal operation of these space objects, including re-entry into the atmosphere from high orbit (i.e., an orbit where the orbital lifetime is sufficiently long to allow for adequate decay of fission products) (The UN General Assembly Resolution No. 47/68, 1992).

b) Nuclear reactors may be operated on interplanetary missions, in sufficiently high orbits, and in low Earth orbits, provided they are stored in orbits at an adequate altitude after the operational phase of their mission. The use of highly enriched uranium-235 as fuel is limited. The design must account for the decay of fission and activation products and ensure that nuclear reactors cannot become critical before reaching their operational orbit or interplanetary trajectory. This includes all possible events such as rocket explosion, re-entry to Earth, impact on land or water, submersion in water, or water intrusion into the reactor core.

c) Safety considerations must be observed when using radioisotope generators on interplanetary missions and other missions leaving Earth's gravitational field. These generators must be protected to withstand the heat and aerodynamic forces resulting from re-entry into the upper atmosphere and impact, ensuring that no radioactive material is dispersed or leaked into the environment until the impact area is fully decontaminated from radioactive activity (The UN General Assembly Resolution No. 47/68, 1992).

The principles also included detailed provisions related to providing assistance to mitigate actual or potential harmful effects, including identifying the impact area of the power source, assessing the safety level and risks of re-entry to Earth, recovery and decontamination operations, and principles related to liability and compensation.

2.2.4. 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 (1997)

This declaration emphasized international cooperation in this field, which should be for the benefit and in the interest of all states, regardless of their level of scientific, economic, social, or technological development, with particular consideration given to the needs of developing countries. It affirmed the freedom of states to determine the aspects of their participation in international cooperation in a fair, acceptable, and mutually agreed manner, consistent with the legitimate rights and interests of the parties involved, such as intellectual property rights. (The General Assembly: Res. 51/122, 1997).

This cooperation should be framed within:

(a) Promoting the development of space science, technology, and their applications;

(b) Encouraging the development of space capabilities;

(c) Facilitating the transfer of technology and the exchange of expertise among states

2.2.5. Guidelines for the Mitigation of Space Debris(2007)

Space debris is defined as man-made objects, fragments of such objects, and their components, located in Earth orbit or re-entering the atmosphere, which are no longer functional. Space debris results from accidental or intentional breakups, debris intentionally released during the operation of spacecraft and orbital stages of launch vehicles, and fragments generated from collisions. It poses a risk to spacecraft in Earth orbit and, more broadly, negatively affects the Earth's environment and outer space, In its resolution 62/217 of 22 December 2007, the General Assembly endorsed (United Nations, 2008, p. 85).

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In its resolution 62/217, adopted on December 22, 2007, the General Assembly approved the Space Debris Mitigation Guidelines formulated by the Committee on the Peaceful Uses of Outer Space. The Assembly acknowledged that these voluntary guidelines encapsulated established practices already developed by various national and international organizations. It further encouraged Member States to adopt and implement these guidelines through appropriate national mechanisms.

The first guideline addresses the issue of limiting debris released during normal operations. Designers of launch vehicles and spacecraft previously allowed the intentional release of numerous mission-related objects into Earth orbit, such as sensor covers and separation mechanisms. Therefore, it has been emphasized that space systems should be designed to prevent the release of debris during normal operations. If this is not feasible, the impact of any debris release on the outer space environment should be minimized.

The second guideline addresses minimizing the potential for breakups during operational phases to the greatest extent possible. This involves ensuring that spacecraft and orbital stages of launch vehicles are designed to avoid malfunctions that could lead to accidental breakups.

The third guideline emphasizes reducing the likelihood of accidental collisions in orbit during the development of spacecraft and launch vehicle designs and the determination of mission profiles.

The fourth guideline calls for avoiding intentional destruction and other harmful activities. Intentional destruction of any spacecraft or orbital stages of launch vehicles in orbit, or any other harmful activities that generate long-term debris, should be avoided (United Nations, 2008, pp. 87-88).

According to the fifth and sixth guidelines, the potential for post-mission breakups due to stored energy should be minimized by either depleting or securing such energy. Additionally, the long-term presence of spacecraft and orbital stages of launch vehicles in the low Earth orbit region after the end of their missions should be limited.

The seventh guideline stipulates limiting the long-term interference of spacecraft and orbital stages of launch vehicles, after the end of their missions, with the geosynchronous orbit region (United Nations, 2008, pp. 88-89).

2.2.6. Key Resolutions of the United Nations General Assembly Related to the Environmental Aspect

Among the most important resolutions in this field is General Assembly Resolution No. 70/208, titled "Harmony with Nature", which affirms that the Earth and its ecological systems are our home and that harmony with nature is essential to achieving a fair balance between the social, economic, and environmental needs of present and future generations (UN General Assembly Resolution No. 70/208, 22 December 2015).

Another significant resolution is Resolution No. 70/82 of 2015, titled "International Cooperation in the Peaceful Uses of Outer Space." This resolution emphasized the importance of international cooperation in upholding the rule of law, including the principles of space law, and the need to adhere to international treaties that promote the peaceful use of outer space. It also highlighted the exchange of information regarding the detection and monitoring of hazardous near-Earth objects to ensure states are aware of the risks they pose. The resolution warned against the dangers of an arms race in outer space, noted the voluntary implementation of space debris mitigation measures by several states in line with the Space Debris Mitigation Guidelines, cautioned against the risks of space object collisions, and underscored the importance of space technology in Earth observation for disaster management and emergency response (UN General Assembly Resolution No. 70/82, 2015).

Other important resolutions in this area include:

- Resolution No. 21/78 on the Prevention of an Arms Race in Outer Space,

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- Resolution No. 52/78 on Transparency and Confidence-Building Measures in Outer Space Activities,
- Resolution No. 72/78 on International Cooperation in the Peaceful Uses of Outer Space,
- Resolution No. 238/78 on Practical Measures to Prevent an Arms Race in Outer Space. This resolution emphasized the urgent need to take immediate and effective measures to prevent the placement of weapons in outer space, the threat or use of force in outer space, and attacks from space to Earth or from Earth against objects in outer space (UN General Assembly, 2024).

Conclusions

The discussion of Earth's environment, outer space, and the associated vertical limits of state sovereignty, as well as environmental issues such as space debris, space burial, and the intentional alteration of planetary environments, deepens the shared understanding of harmony with nature. It underscores the need to approach the environment with a perspective of coexistence and respect, rather than absolute domination and exploitation rooted in the concept of absolute sovereignty. This requires moving away from a negative understanding of control and exploitation toward genuine international cooperation based on the idea of building and preserving the Earth and the universe. In this context, the view of Earth as a shared vessel for humanity should be expanded to encompass the entire cosmos.

his study has led the researcher to the following key findings and recommendations:

Results

1. The international understanding of the environment must expand to include outer space, while national definitions should broaden in line with the extent of state sovereignty over outer space.
2. The determination of a clear boundary separating outer space from airspace, which falls within state sovereignty, remains a contentious issue and a foundational challenge for its legal definition.
3. Effective international supervision of the geostationary orbit (GSO) is essential to ensure its use for the benefit of humanity and to prevent misuse, such as the placement of satellites with military or hazardous missions that could endanger states over which the orbit passes or contribute to space debris.
4. The Moon Agreement explicitly designates the Moon and its natural resources as the "common heritage of mankind," extending this principle to outer space. This implies that protecting the outer space environment is a shared responsibility of all states.
5. The argument that there is no need to define a boundary between airspace and outer space, based on the lack of state objections to satellite overflights, is untenable. Defining such a boundary would not hinder space technology or exploration but could positively contribute to technological advancement.
6. In the absence of international agreement on the boundary of outer space, the researcher supports the scholarly call for a consensual solution through the international community, treating the issue as a legal rather than purely scientific problem.
7. Space activities pose several environmental risks, including space pollution (e.g., orbital debris), radiation hazards affecting both outer space and Earth's environment and the emerging risk of using satellites to harness solar energy, which could negatively impact the ozone layer and air navigation.
8. The Moon Agreement obligates states to take measures to prevent the disruption of the Moon's environment, including harmful contamination, and to avoid adverse effects on Earth's environment through the introduction of extraterrestrial matter.
9. States launching space objects with nuclear power sources must ensure the protection of individuals, communities, and the biosphere from radiation risks.
10. Space systems should be designed to prevent the release of debris during normal operations. Where this is not possible, the impact of debris on the outer space environment should be minimized.

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DOI: https://doi.org/10.62754/joe.v4i2.5864

11. Measures should be taken to limit the long-term presence of spacecraft and launch vehicle stages in the geostationary orbit after the end of their missions.

B-Recommendations:

1. International and national legal frameworks should explicitly include outer space within the definition of the environment, reflecting the interconnectedness of Earth and space ecosystems.
2. The international community should work toward defining a clear boundary between airspace and outer space, addressing both legal and scientific considerations.
3. Mechanisms for international oversight of the geostationary orbit and other critical space regions should be established to ensure their sustainable and peaceful use.
4. Efforts should be made to increase the acceptance and implementation of the Moon Agreement, emphasizing the principle of the "common heritage of mankind" for outer space resources.
5. States and private entities should adhere to space debris mitigation guidelines and invest in technologies for debris removal and prevention.
6. Strict safety standards should be enforced for the use of nuclear power sources in space, with a focus on minimizing radiation risks and environmental contamination.
7. Genuine international cooperation should be promoted to address environmental challenges in outer space, ensuring that space activities benefit all humanity.
8. Legal and scientific communities should collaborate to develop comprehensive solutions to environmental issues in outer space, balancing technological advancement with environmental protection.

This conclusion and the accompanying recommendations aim to contribute to the ongoing discourse on the legal and environmental aspects of outer space, emphasizing the need for a harmonious and cooperative approach to space activities.

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