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# The Elusive Boundary: Why Defining Airspace and Outer Space Matters

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***Abstract:***

*The Space Age has witnessed a dramatic rise in humanity's exploration and utilization of outer space. This expansion has necessitated the development of a sophisticated legal framework known as international space law to govern these activities. However, a fundamental and persistent issue continues to plague this legal domain: Absence of well-defined boundary between airspace and the outer space.*

*For over five decades, the question of where air ends and space begins has remained perplexingly unresolved. Despite the lack of an official demarcation line, significant problems have not yet materialized. Nevertheless, concerns persist among both political and legal specialists regarding potential future complications.*

*This study explores the causes of the current controversy and the repercussions of this legal loophole. This study investigates the difficulties presented by the rise of novel "aerospace objects" - vehicles that function in both atmospheric and outer space conditions. The study advocates for a renewed*

*emphasis on defining the border between space and outer space by taking into account the effects of these technological breakthroughs. The examination examines the reasons why a distinct boundary may become more significant in the future, even if it hasn't been crucial up to this point. In conclusion, the paper highlights the importance of continuous research and dialogue on this subject 1 to 2 provide a strong legal structure for the always changing field of space exploration.*

***Keywords****: space, air, aerospace, NASA, border,*

## Introduction:

Gazing at the stars, the Earth-space divide seems absolute. Yet, as humanity ventures beyond our planet, the legal and practical realities become murkier. With a surge in commercial spaceflights, high-altitude balloons, and advanced spacecraft, a crucial question arises:

## Where precisely does air yield to outer space?

International space law offers no universally accepted answer, creating a grey area with significant legal and regulatory ramifications. This article explores this intricate issue of the air-space boundary. We'll delve[1] into the history of air and space law, examining the key treaties that establish these frameworks but leave the boundary undefined. We'll then

analyse proposed solutions, including the influential 100km Kármán Line, the functional approach based on vehicle capabilities, and the spatial approach advocating for a fixed altitude demarcation.

Next, we'll dissect the legal and regulatory challenges posed by the unclear boundary, focusing on issues like jurisdiction, traffic management, and military activities. Finally, we'll discuss ongoing discussions and potential solutions under 5the United Nations Committee on the Peaceful Uses of Outer Space[2] (COPUOS) before concluding with a forward-looking analysis of this boundary's future.

While distinct areas of study,16air and space law are sometimes combined as "aerospace law." Air law encompasses both public and private regulations governing aviation and airspace use. 3Space law, on the other hand, coordinates the activities of both private and public entities in outer space.

The Space Age dawned with the Soviet Union's launch of Sputnik I, the first artificial satellite. Since then, the United Nations Committee on Peaceful Uses of Outer Space has primarily overseen space operations. Five primary agreements provide a comprehensive set of space legislation. The Five primary agreements provide a comprehensive set of space legislation. The most notable is the 1967 Outer space Treaty,

which established several fundamental principles:

- Unrestricted exploration and access to outer space.
- Prohibition of territorial claims in outer space by any nation.
- Strict ban on the use of Weapons of Mass Destruction [3](WMDs) in outer space.

The key difference between space law and air law lies in the legal categorization of outer space and international airspace. Unlike the high seas and Antarctica, airspace remains regulated and controlled by individual states. However, 3outer space is governed by the principle of freedom.

The line between air and space remains undefined. While a 100km-altitude boundary from mean sea level is anticipated, a definitive answer is expected soon.

**Bridging the Gap: Towards a Clearer Air-Space Divide:**

In a perfect world, air and space laws might be polar opposites. After all, air sovereignty grants nations control over their airspace. Space law, on the other hand, operates under the principle of "the province of all mankind," meaning no single country owns it.

Security traditionally falls under a nation's purview, giving them significant influence in both air and space law. The challenge lies in regulating these transparent and vast environments. Unlike land, where borders are clear, aircraft can freely navigate airspaces, unhindered by mountains or oceans.

The line between air space and outer space is blurry. While some legal experts propose a 100-kilometre altitude as the boundary, there's currently no definitive demarcation. As commercial space activities boom, establishing a clear distinction becomes crucial for smoother regulation and development. Outer space serves a multitude of purposes, from scientific research and weather monitoring to military applications. Satellites, observatories, and spacecraft all operate in this realm, highlighting the importance of national security concerns alongside international cooperation in space exploration.

**Significant distinction:**

Air law and space operate on vastly different legal maps. Air law relies on a robust network of international treaties, bilateral agreements between countries, and established customs. Space law, on the other hand, draws from a mix of multilateral conventions, bilateral agreements, international resolutions, and national regulations.

The core difference boils down to ownership. Air law grants individual states complete control over their airspace, as enshrined in Article 1 [4]of the Chicago Convention. In stark contrast, the Outer Space

Treaty (Article II) explicitly forbids any nation from claiming ownership of outer space. Professor Steven Truxel aptly summarizes this concept: a nation's air authority ends where another's begins.

Another key discrepancy lies in liability. Under air law, the Warsaw and Montreal Conventions hold the air carrier responsible for passenger injuries or damages. Space law, however, assigns liability to the nation that launches the spacecraft, as outlined in the Liability Convention and the Outer Space Treaty.

This lack of a clear boundary between air and space law creates a major hurdle. Without a definitive line, it's difficult to determine which set of regulations applies and which organization oversees activities like suborbital flights. A well-defined boundary would enable nations to identify the appropriate governing body, assess potential risks, and pinpoint the country responsible for upholding international obligations.

**Carving Up the Cosmos: Three Ways to Define Outer Space:**

Within the space community, three primary contenders have emerged for defining the boundary of outer space: (i) the Karaman Line, (ii) The Astronaut Badge Line, and (iii) The Mission Intent Line.

1. **The Karman Line:**

This 100-kilometer (62-mile) high invisible wall, named after Hungarian-American scientist Theodore von Karman, is the current favourite of the World Air Sports Federation (FAI)[5]. Here's the science behind it: at this altitude, the atmosphere thins out so much that traditional flight using lift becomes impossible. Instead, an object needs near-orbital speed to stay aloft, essentially falling around the Earth. While von Karman's research wasn't intended to define a space border, it's become a popular choice. However, some argue it ignores the actual point where aerodynamic control is lost (which some say is lower) and might not hold true with future advancements in technology.

Pioneering aerospace research by Theodore von Karman[6] revealed a critical altitude where the atmosphere thins dramatically. At this point, the forward thrust required to maintain flight becomes nearly equivalent to, or even exceeds, the orbital speed necessary to stay aloft. Centrifugal forces come into play, counteracting gravity and allowing the object to remain airborne solely through freefall, not forward propulsion. In essence, orbital mechanics (including freefall) take precedence over aerodynamic principles (like lift) at this specific altitude.

Von Karman's calculations placed this point at approximately 83.8 kilometres (52 miles) above mean sea level. While not initially intended as a boundary for outer space, his findings were later adapted for this purpose. To simplify and improve memorability, von

Kármán, in collaboration with the FAI (Federation Aeronautique Internationale), opted for a round number: 100 kilometres. Thus, the now-famous "Karman Line" was born.

1. **The Astronaut Badge Line:**

The FAI, currently using the Karman Line, is considering a new contender[7]: the Astronaut Badge Line at 80 kilometres (50 miles) above sea level. This altitude isn't random. It aligns with the threshold for receiving an astronaut badge in the US (by NASA, FAA, and the Air Force). The US, a major space player[8], implicitly acknowledges activities above this line as space-related by awarding these badges. Scientifically, it also aligns better with von Kármán's research, where orbital mechanics become more important than lift for staying aloft.

There are multiple issues arising that delay or create an administrative and executive disturbance in officially recognizing the Astronaut Badge Line. Politics play a role. With its strong air force, the US might be hesitant to adopt a lower boundary. Easier access to "outer space" through commercial[9] ventures could disrupt the current dynamic where only a few countries can perform "spaceflights" over others' territories. Similarly, countries without advanced air capabilities might see this line as too low to prevent unwanted surveillance flights. The lack of global agreement on this front makes the Astronaut Badge Line a tough sell, despite its scientific grounding and implicit US support.

1. **The Mission Intent Line:**

Proposed by Thomas Gangale, it focuses on the object's intended destination rather than altitude. Basically, if something aims for outer space, it's considered a spacecraft even if it doesn't make it. This means any legal issues arising from a failed launch would be handled by space regulations, not airplane rules. This approach relies on the object's intention, which can be subjective. Imagine someone launching something claiming it's going to space, even if it's not. This subjectivity could lead to people manipulating the system to benefit from whichever legal regime suits them best. Enforcing such a system would be a nightmare while the Mission Intent Line offers an interesting perspective[10], the potential for abuse and the difficulty of enforcement makes it a less practical contender for the official outer space boundary.

The concept of the Mission Intent Line, a proposed boundary between air and outer space, carries significant legal weight for space exploration. Venturing beyond this line can trigger a cascade of legal consequences across several key areas:

- **Jurisdiction:** Disagreements might arise about which nation's laws govern the space activity once the Mission Intent Line is crossed. Different countries have varying regulations for space exploration. The specific location of the spacecraft or mission could determine which country holds legal authority.
- **Ownership Rights:** For commercial entities engaged in space mining, crossing this boundary could potentially affect their legal ownership of extracted resources. Their rights to use and sell these materials might also be called into question.
- **Compliance with International Law:** Disregarding the Mission Intent Line could lead to violations of treaties

and agreements governing international space activities. The 1967 Outer Space Treaty, for example, sets forth principles for space exploration and utilization. Crossing the line could trigger legal consequences under international space law.

- **Conflict Resolution:** If disagreements or conflicts arise due to activities beyond the Mission Intent Line, established frameworks for resolving such disputes and determining jurisdictional authority would come into play. Resolving conflicts in outer space often requires adherence to international agreements and norms, and can involve complex legal considerations.

In short, the Mission Intent Line serves as a potential legal tripwire for space exploration. Crossing it could trigger a range of legal issues related to jurisdiction, ownership, international law compliance, and conflict resolution.

**Challenges of International Air Travel Border Crossings:**

International law grants every nation the right to control and protect its airspace. These regulations mirror those governing the "high seas" in maritime law, with horizontal boundaries marking out airspace zones. Just as with the oceans, a country can, with international approval, take responsibility for safeguarding and managing specific international airspaces, such as those over the Pacific Ocean.

However, to ensure the safety and order of international air travel, national airspace is restricted. Only authorized foreign airlines can operate scheduled international flights within another country's airspace. Unapproved foreign aircraft are strictly prohibited from entering a nation's airspace without proper clearance. Failure to comply with these regulations can have serious consequences, potentially leading to interception and diversion of the aircraft to a designated airport. While uncommon, such incidents occur a few times a year in Dutch airspace alone, highlighting the potential severity of these border-crossing difficulties.

The observation of unscheduled aircraft traversing diverse geographical zones during both World Wars exposed a critical regulatory gap in international air law. This security concern spurred the development of significant aviation conventions, most notably the Paris Convention and the Chicago Convention. Following World War II, these agreements became the cornerstone of international civil aviation regulation. The conventions outlined essential principles governing international air services, emphasizing the importance of safe operational practices and strict adherence to national airspace boundaries.

Regulations delineating the national airspace of countries are established in accordance with the Chicago Convention. These regulations establish legal boundaries between states in the absence of physical boundaries such as mountains, rivers, lakes, and oceans. The opening of these boundaries is contingent upon a consensus among the pertinent governmental bodies. The public importance of air transport and space systems around the globe is a primary justification for the establishment of air and space laws as a fundamental area of law. As such, nations have a vested interest in regulating these systems. It must be executed in accordance with their precise directives and under their direct supervision.

**Conclusion:**

This study has conducted a separate analysis of airspace and outer space, examining their characteristics and the legal frameworks that govern them. It then tried to reassemble them to show that a wider perspective, namely focusing on the possibility of using force against aerospace vehicles, can assist illustrate how the systems are interconnected. The definitive conclusion is that the boundary separating[11] the Earth's atmosphere from outer space is located at the orbit level. However, the fact that these aerospace vehicles and usages are relatively new does not imply that they lack any prior examples or instances. Take submarines as an example. They brought about new considerations regarding the use of force in maritime law, but were subsequently incorporated framework of self-defence and security.

Although the principles of the law of the sea cannot be directly applied to outer space law, they serve as an example of how new capabilities that challenge traditional boundaries might be included into a structured system. Submarines had the freedom to operate in their distinctive manner - submerged and hidden - on the open ocean. However, when the capacity of submarines to operate along the shores of a State clashed with the State's worries about its sovereignty, the distinctive characteristics of submarines were virtually disregarded in order to prioritise coastal State. The presence of aerospace vehicles poses a distinct and novel challenge to the establishment of sovereignty.

However, the emergence of a new threat to territorial integrity does not necessarily imply a reduction in sovereignty. Undoubtedly, the matter might be resolved through a convention or treaty. States could potentially establish a formal regulatory framework for aerospace vehicles. However, it is also conceivable that, similar to the case of submarines and aeroplanes, governments may prioritise their sovereignty over unrestricted utilisation of a novel application. Until that occurs, states must adhere to the existing law and its current boundaries, which are determined by the states' inclination towards sovereignty and limited only by their desire to facilitate freedom of movement in space and beyond.

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