วารสารนิติศาสตร์
มหาวิทยาลัยธรรมศาสตร์
THAMMASAT LAW JOURNAL

ชื่อเรื่อง: ระหว่างอธิปไตยและเสรีภาพ : ความท้าทายทางกฎหมายและแนวโน้มในการกำหนดเขตแดนอากาศและอวกาศ

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การอ้างอิงที่แนะนำ: แอนเดรียส เซลา, ‘ระหว่างอธิปไตยและเสรีภาพ : ความท้าทายทางกฎหมายและแนวโน้มในการกำหนดเขตแดนอากาศและอวกาศ’ (2569) 55(1) วารสารนิติศาสตร์ มหาวิทยาลัยธรรมศาสตร์ 247.

โครงการวารสารนิติศาสตร์ มหาวิทยาลัยธรรมศาสตร์
คณะนิติศาสตร์ มหาวิทยาลัยธรรมศาสตร์ เลขที่ 2 ถนนพระจันทร์ แขวงพระบรมมหาราชวัง เขตพระนคร กรุงเทพมหานคร 10200 อีเมล tu.lawjournal@tu.ac.th

Between Sovereignty and Freedom: Legal Challenges and Prospects for Delimiting Airspace and Outer Space
ระหว่างอธิปไตยและเสรีภาพ : ความท้าทายทางกฎหมายและแนวโน้มในการกำหนดเขตแดนอากาศและอวกาศ

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วันที่รับบทความ 25 กรกฎาคม 2568; วันแก้ไขบทความ 1 ตุลาคม 2568; วันตอบรับบทความ 16 ตุลาคม 2568

บทคัดย่อ

บทความนี้ศึกษาประเด็นปัญหาทางกฎหมายที่มีมาอย่างยาวนานเกี่ยวกับการกำหนดเส้นแบ่งเขตระหว่างห้วงอากาศซึ่งรัฐมีอำนาจอธิปไตยโดยสมบูรณ์ กับอวกาศซึ่งอยู่ภายใต้หลักเสรีภาพในการใช้ประโยชน์และหลักการห้ามยึดครองเอาเป็นของตน การขาดซึ่งขอบเขตที่ได้รับการยอมรับโดยทั่วไปนี้ ก่อให้เกิดความไม่แน่นอนทั้งในเชิงกฎหมายและทางปฏิบัติสำหรับทั้งรัฐและผู้ประกอบการเชิงพาณิชย์โดยเฉพาะอย่างยิ่งท่ามกลางการพัฒนาเทคโนโลยีใหม่

บทความนี้อ้างอิงสนธิสัญญาระหว่างประเทศ การปฏิบัติของรัฐ บทบัญญัติในลักษณะกฎหมายอ่อน (soft law instruments) ตลอดจนทฤษฎีทางวิชาการต่าง ๆ ได้แก่ แนวคิดเชิงพื้นที่ (spatialist approach) แนวคิดเชิงหน้าที่ (functionalist approach) และแนวคิดระหว่างห้วง (interspace approach) เพื่อนำมาวิเคราะห์หลักการทางกฎหมายที่แตกต่างกันและประเมินความเป็นไปได้ของแต่ละแนวทางในทางปฏิบัติ

ผลการวิเคราะห์ชี้ให้เห็นว่า แม้การกำหนดเส้นแบ่งความสูงที่แน่นอน เช่น เส้นคาร์มัน (Kármán line) จะช่วยสร้างความชัดเจนทางกฎหมายได้ แต่ก็อาจล้าสมัยเมื่อเทคโนโลยีมีการพัฒนา ขณะที่แนวทางเชิงหน้าที่มีความเสี่ยงต่อความไม่แน่นอนในทางกฎหมาย บทความแสดงให้เห็นว่า

แนวคิดทางกฎหมายแบบผสมผสานอย่าง “ทฤษฎีระหว่างห้วงอวกาศ” (interspace theory) เป็นแนวทางที่มีศักยภาพในการพัฒนาในอนาคต แต่ยังคงเผชิญอุปสรรคสำคัญทั้งทางการเมืองและทางกฎหมาย

โดยสรุป แม้การทำสนธิสัญญาที่มีผลผูกพันในเรื่องนี้ยังคงเป็นสิ่งที่ยากจะบรรลุได้ แต่ก็สามารถสร้างความก้าวหน้าได้อย่างค่อยเป็นค่อยไป ผ่านกลไกกฎหมายอ่อน ความตกลงในระดับภูมิภาค และการพัฒนาของกฎหมายจารีตระหว่างประเทศในระยะยาว การสร้างความชัดเจนในสถานะทางกฎหมายของการทำกิจกรรมใกล้อวกาศจึงเป็นสิ่งจำเป็น เพื่อทำให้ความไม่เป็นเอกภาพของกฎหมายลดน้อยลง เสริมสร้างความมั่นคงทางกฎหมาย และสนับสนุนการเติบโตอย่างยั่งยืนของกิจกรรมอวกาศเชิงพาณิชย์

คำสำคัญ : การแบ่งเขตอวกาศ อธิปไตยอากาศ เส้นคาร์มัน ทฤษฎีหน้าที่ ทฤษฎีพื้นที่ กฎหมายที่ไม่มีผลผูกพัน แนวคิดช่องว่าง

Abstract

This article investigates the longstanding legal dilemma of how to define the boundary between airspace, where states exercise full sovereignty, and outer space, which is governed by principles of freedom of use and non-appropriation. The lack of a universally accepted delimitation creates legal and operational uncertainties for both states and commercial actors, especially amid emerging technologies. Drawing on international treaties, state practice, soft law instruments, and scholarly theories, including spatialist, functionalist, and interspace approaches, this paper analyzes the competing legal doctrines and assesses their practical viability. The analysis shows that while fixed altitude boundaries such as the Kármán line provide clarity, they may become obsolete with technological advances, whereas functionalist solutions risk legal unpredictability. The paper argues that hybrid legal concepts like the interspace theory offer promising paths forward but face significant political and legal hurdles. It concludes that, although a binding treaty remains elusive, incremental progress is possible through soft law, regional agreements, and the gradual development of customary international law. Clarifying the legal status of near-space operations is essential to mitigate regulatory fragmentation, enhance legal certainty, and enable the sustainable growth of commercial space activities.

Keywords: Space Delimitation, Airspace Sovereignty, Kármán Line, Functional Theory, Spatial Theory, Soft law, Interspace Theory

1. Introduction

Despite decades of technological advances and legal discussions, the international community has yet to agree upon a universally accepted demarcation separating sovereign airspace from outer space, which is governed by entirely different legal principles.[1] This absence of delimitation has implications for state sovereignty, national security, commercial investment, and the future of human activity beyond Earth.

The divergence between air law and space law is rooted in their historical development. Air law emerged in the early 20th century from the imperative of protecting national sovereignty and security in the wake of aviation's rise.[2] By contrast, space law was born in the geopolitical tensions of the Cold War, built on principles of freedom of use, non-appropriation, and the common interest of humanity.[3] Several theories have attempted to resolve the delimitation question. Spatialist approaches propose a fixed physical boundary, most famously the Kármán line at 100 kilometers altitude, although some experts argue for a lower threshold based on aerodynamic realities. Functionalist theories, on the other hand, suggest that legal regimes should be defined by the nature or purpose of the activity rather than by altitude alone. More recent proposals, including the Interspace-Theory inspired by maritime law's Exclusive Economic Zone, seek compromise by creating transitional legal zones with hybrid characteristics.

The urgency of resolving the delimitation question is growing. Technological developments increasingly operate across traditional legal boundaries.[4] The current "grey zone" creates regulatory uncertainty, complicating licensing, liability, and the

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[1] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' in Nicolas Mateesco Matte (ed) *Annals of Air and Space Law Volume 5* (Institute of Air and Space Law, McGill University 1980) 323–338.

[2] Convention Relating to the Regulation of Aerial Navigation (adopted 13 October 1919, entered into force 29 March 1922) 11 LNTS 173 (Paris Convention) art 1.

[3] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies (adopted 19 December 1966, entered into force 10 October 1967) 610 UNTS 205 (Outer Space Treaty) art I.

[4] See generally Tommaso Sgobba, 'Space Safety and Human Performance' (Oxford: Butterworth-Heinemann, 2018), 275-311.

enforcement of national security measures.[5] The absence of clarity also challenges the ability of private actors to secure financing and insurance for aerospace ventures, potentially stifling innovation. Despite repeated debates at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and in academic forums, no consensus has been reached. Many states prefer maintaining the current legal ambiguity, fearing that defining a boundary could constrain future technological and strategic flexibility.[6] However, indefinite postponement of a legal solution risks leaving a vacuum that may ultimately lead to conflicts or fragmented national regulations.[7]

This paper seeks to explore why delimitation remains so elusive and to assess the legal, technological, and practical challenges involved. It examines the historical foundations of air and space law, analyzes existing theoretical approaches, and evaluates their viability in light of modern technologies. Particular attention is given to the Interspace-Theory and proposals for creating intermediate zones, which, in the author's view, offer promising pathways for reconciling the conflicting principles of sovereignty and freedom of space. The paper further considers whether instruments of treaty law, soft law, or customary international law might finally provide the international community with a stable framework for resolving this legal uncertainty. Existing scholarship on the delimitation of airspace and outer space has concentrated primarily on the opposition between spatialist and functionalist approaches, debating whether a fixed altitude boundary or an activity-based criterion should govern the transition between the two regimes. While these theories remain influential, they have not resolved the practical and political impasse in international fora, particularly within COPUOS, nor do they adequately address the challenges posed by new aerospace technologies and commercial ventures. Hybrid models such as the interspace approach have been introduced in legal literature, but they are often treated only as tentative thought experiments rather than as systematic frameworks with direct applicability to regulatory and policy needs. This article seeks to fill that gap by offering a structured and policy-relevant analysis of the Interspace approach, situating it within both doctrinal

[5] Roy Balleste, 'Worlds Apart: The Legal Challenges of Suborbital Flights in Outer Space' (2017) 49(4) New York University Journal of International Law and Politics 1033, 1033–1062.

[6] Dean N Reinhardt, 'The Vertical Limit of State Sovereignty' (2007) 72(1) Journal of Air Law and Commerce 65, 65–140.

[7] Hao Liu and Fabio Tronchetti, 'Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model?' (2019) 50(2-3) Ocean Development and International Law 91, 91–116.

debates and the realities of emerging practices such as space tourism, reusable launch vehicles, and high-altitude pseudo-satellites. In doing so, it contributes to bridging the divide between legal theory and practical governance, underscoring how hybrid concepts can enhance legal certainty, balance sovereignty with the freedom of outer space, and provide incremental solutions in the absence of a universally agreed treaty framework. Ultimately, resolving the delimitation problem is not merely an academic exercise. It is a question central to how humanity will regulate its future expansion into the space frontier, ensuring legal certainty, sustainable development, and peaceful cooperation in an era of unprecedented technological transformation.

2. Historical Development of Air Law and Space law

The legal uncertainty surrounding the boundary between airspace and outer space is best understood through the historical paths taken by air law and space law. Although both legal regimes concern activities above Earth's surface, they originated in starkly different geopolitical, technological, and philosophical contexts, resulting in two fundamentally distinct systems of law.

The origins of modern air law trace back to the rapid development of aviation technology in the early 20th century. Before powered flight, the vertical extent of state sovereignty remained largely academic, with legal theory occasionally analogizing airspace to the high seas, open to free passage.[8] The advent of aviation changed this perspective. The Convention Relating to the Regulation of Aerial Navigation of 1919 (the Paris Convention) firmly established that "*every state has complete and exclusive sovereignty over the airspace above its territory.*"[9] This concept was later reinforced by the Convention on International Civil Aviation of 1944 (the Chicago Convention), which remains a cornerstone of air law.[10] These provisions reflected the international consensus that states must retain absolute control over their skies to protect their territorial integrity and security. Yet, while sovereignty was asserted vertically "upward," neither the Paris nor the Chicago Convention defined how far that sovereignty extends

[8] Joanne Irene Gabrynowicz, 'Space Law: Its Cold War Origins and Challenges in the Era of Globalization' (2004) 37 Suffolk University Law Review 1041, 1045–1051.

[9] Paris Convention art 1.

[10] Convention on International Civil Aviation (adopted 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 (Chicago Convention) art 1.

into the upper atmosphere or beyond, leaving the question of where airspace ends open.[11]

In stark contrast, space law emerged during the geopolitical tensions of the Cold War. The launch of Sputnik 1 by the Soviet Union in 1957 not only marked a technological milestone but also triggered urgent legal debates about the nature of the domain above national airspace.[12] Unlike aircraft, Sputnik orbited Earth, passing repeatedly over national territories without permission, realizing a hypothetical scenario that was not fully covered under the air law's sovereignty principle. This led to a profound philosophical shift. Rather than extending sovereignty into space, the international community opted for a legal framework rooted in freedom and non-appropriation. The 1967 Outer Space Treaty (OST) declared that outer space, including the Moon and other celestial bodies, "*shall be free for exploration and use by all States" and "is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means*."[13] This marked a departure from the territorial focus of air law, aiming instead to preserve outer space as a global commons for the benefit of all humanity.[14] The emergence of space law was also intertwined with the creation of COPUOS in 1958. Initially, a small ad hoc committee of member states, COPUOS quickly became the central forum for negotiating the principles that would shape space law.[15] Its work produced crucial instruments such as the Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space in 1963, which laid the groundwork for the OST.[16]

This historical divergence left the international legal order with two regimes built on fundamentally different doctrines: absolute sovereignty in airspace, and freedom and non-appropriation in outer space. The practical result has been the

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[11] Paul Stephen Dempsey and Maria Manoli, 'Suborbital Flights and the Delimitation of Air Space vis-à-vis Outer Space: Functionalism, Spatialism and State Sovereignty' (2017) 42 Annals of Air and Space Law 197, 201.

[12] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 323–338.

[13] Outer Space Treaty art II.

[14] Stephan Hobe, 'Legal Aspects of Space Tourism' (2007) 86(2) Nebraska Law Review 439, 441–445.

[15] United Nations 'Report of the Committee on the Peaceful Uses of Outer Space' (1959) UN Doc A/4141.

[16] United Nations General Assembly 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space' (1964) UN Doc A/RES/1962(XVIII).

creation of a legal "grey zone" between the highest reaches of controlled airspace and the lower reaches of outer space, where no clear legal rules define the applicable regime. The question of delimitation has been a recurring topic in COPUOS discussions since its earliest sessions. As early as 1959, the Legal Subcommittee acknowledged that "*a clear definition of outer space would become necessary*" as technology advanced.[17] Yet consensus proved elusive, largely because states feared that fixing a boundary might constrain future technological developments or geopolitical flexibility. Throughout the 1970s and 1980s, various states submitted proposals suggesting altitude-based definitions, often referencing the Kármán line or other physical criteria. However, COPUOS reports consistently record that "*no agreement was reached*," with delegations divided between spatialist and functionalist approaches.[18] As COPUOS noted in 1996, states continue to consider that there is no pressing practical need to establish a legal boundary between airspace and outer space.[19] The topic has remained on its agenda intermittently in subsequent decades. In its 2019 report, the Legal Subcommittee reiterated that "*States continue to differ in their views*" and that "*a universally agreed boundary has not yet emerged.*"[20] These UN debates can be observed as evidence that the absence of delimitation is not merely technical, but the result of deliberate political and legal caution.[21]

Originally, the technological distinction between aircraft and spacecraft seemed clear: aircraft generated lift from aerodynamic forces and required atmospheric oxygen for propulsion, while spacecraft relied on rocket propulsion and orbital mechanics.[22] However, technological advances have blurred this distinction. Reusable launch vehicles, suborbital spaceplanes, high-altitude pseudo-satellites, and other hybrid

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[17] United Nations, 'Report of the Committee on the Peaceful Uses of Outer Space' (n 15) para 32.

[18] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), Historical summary on the consideration of the question on the definition and delimitation of outer space: report of the Secretariat, UN Doc. A/AC.105/769 para 25.

[19] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), Report of the Legal Subcommittee on the work of its nineteenth session, UN Doc. A/AC.105/271 (1980), paras. 33–36.

[20] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (2019) UN Doc A/AC.105/1203 para 116.

[21] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 324–326.

[22] Theodore von Kármán, Toward New Horizons: A Report to General of the Army H. H. Arnold on the Future of the United States Air Force (Washington, DC: U.S. Government Printing Office, 1946), 18.

vehicles now routinely traverse altitudes that overlap both airspace and outer space.[23] This existing legal vacuum creates real risks, leaving both states and private actors uncertain about the legal consequences of operations in transitional altitudes.[24] This legal vacuum persists even as commercial activities and technological innovations increasingly operate in transitional altitudes. The challenge for international law is how to reconcile these divergent legal traditions to create a coherent and functional legal framework for aerospace operations.

3. The Legal Necessity of Delimitation

The unresolved question of where airspace ends and outer space begins is not merely theoretical but is central to the coherence of international law and the practical functioning of modern aerospace activities. The absence of delimitation creates uncertainty that affects core principles of sovereignty, regulatory regimes, commercial operations, and the stability of international relations.

Sovereignty and Legal Order

International law is built upon the territorial sovereignty of states, while outer space law, in contrast, rests on the principle that space is free for exploration and use by all, without national appropriation.[25] These incompatible principles coexist uneasily without a defined vertical boundary to mark where one legal regime ends, and the other begins.

This legal ambiguity directly affects the exercise of state sovereignty. Without delimitation, states cannot precisely determine the vertical limits of their territorial jurisdiction, leading to uncertainties in enforcing national laws, protecting security interests, or controlling the use of emerging aerospace technologies near their borders.[26] The absence of a defined boundary risks conflicts over surveillance activities, overflights, and the movement of high-altitude vehicles that may traverse both legal domains.[27] Without a clear boundary, military and intelligence operations risk being misinterpreted, potentially escalating geopolitical tensions.

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[23] Tommaso Sgobba and V K Gupta (n 4).

[24] Dean N Reinhardt (n 6) 65–140.

[25] Outer Space Treaty art I.

[26] Dean N Reinhardt (n 6) 65–140.

[27] Roy Balleste (n 5) 1033–1062.

Commercial Operations and Regulatory Certainty

Beyond state interests, the lack of delimitation also creates substantial challenges for private entities engaged in commercial aerospace ventures. Companies planning suborbital flights, high-altitude telecommunications services, or reusable launch operations face a fragmented legal landscape in which it is unclear whether air law or space law applies to their activities.[28] This uncertainty complicates regulatory approvals, insurance underwriting, liability assessments, and contractual relationships.

Especially suborbital vehicles, which are spacecrafts or rockets designed to reach the edge of space, typically crossing the Kármán line at about 100 kilometers above sea level, but they do not achieve the speed required to stay in space or complete an orbit around the Earth; instead, after reaching their highest point, they follow a curved path back down to the surface, allowing passengers to experience a brief period of weightlessness and see the curvature of the planet before returning. This Space Tourism activity exists "in a legal limbo," creating business risks for operators and investors.[29] Any commercial activity that expands into near space, leaving the boundary undefined, jeopardizes legal certainty and could hinder economic development. Insurance markets also suffer from this ambiguity. Liability regimes differ sharply between air and space law. Aviation law imposes strict or absolute liability for damage caused by aircraft, while space law (under the 1972 Liability Convention) differentiates between damage on Earth (absolute liability) and damage in outer space (fault-based liability).[30] In cases involving reusable vehicles that traverse both domains, it becomes unclear which legal regime applies.[31] Such uncertainties significantly complicate risk assessment and insurance pricing, creating barriers to private investment.

International Stability and Rule of Law

A further reason for delimitation is the broader interest in legal certainty and the rule of law. As *Liu and Tronchetti* argue, the absence of a boundary risks fragmented national regulations, which could result in conflicting claims and legal disputes between

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[28] Paul Stephen Dempsey and Maria Manoli (n 11) 199–215.

[29] Roy Balleste (n 5) 1045–1049.

[30] Convention on International Liability for Damage Caused by Space Objects (adopted 29 March 1972, entered into force 1 September 1972) 961 UNTS 187 (Liability Convention) arts II–III.

[31] Dean N Reinhardt (n 6) 80–83.

states.[32] *Reinhardt* similarly warns that without a clear delimitation, states might impose unilateral measures leading to diplomatic conflicts and undermining the cooperative spirit of the OST.[33] Moreover, the lack of delimitation may hinder the development of customary international law. COPUOS discussions indicate that while states have not yet reached consensus on a boundary, ongoing state practice and *opinio juris* could eventually crystallize into a customary rule. However, this process remains stalled because of diverging national interests and technological uncertainties.

Technological Imperatives

Advances in aerospace technology have further exposed the inadequacies of maintaining a legal vacuum. Vehicles such as SpaceShipTwo and New Shepard routinely operate at altitudes between 80 and 120 kilometers, specifically in the zones where the legal regime remains ambiguous. The physical characteristics of flight above 80 kilometers are fundamentally different from aeronautics, suggesting that a boundary around this altitude would reflect technological realities.[34] While earlier distinctions between aircraft and spacecraft seemed clear, contemporary vehicles increasingly operate in transitional altitudes that do not fit neatly into either legal regime.

The Need for Legal Predictability

Ultimately, legal predictability is vital for both states and private actors. As *Bin Cheng* emphasizes, "Uncertainty breeds disputes, discourages investment, and undermines confidence in the legal order."[35] The longer the delimitation question remains unresolved, the greater the risk that states will adopt divergent domestic laws, creating a fragmented legal landscape that could hamper the growth of the space economy and increase geopolitical tensions. Resolving this issue is therefore not merely an academic exercise. It is essential to ensure legal certainty, promote sustainable

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[32] Hao Liu and Fabio Tronchetti, 'The Exclusive Utilization Space: A New Approach to the Management and Utilization of the Near Space' (2019) 40(3) University of Pennsylvania Journal of International Law 537, 537–574.

[33] Dean N Reinhardt (n 6) 102–106.

[34] Jonathan C McDowell, 'The Edge of Space: Revisiting the Kármán Line' (2018) 151 Acta Astronautica 668, 668–677.

[35] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 324.

development, and preserve the cooperative principles that have governed outer space since the dawn of the Space Age.

4. Theories on Delimitation

To avoid the problems caused by a missing delimitation mentioned above, there have been several theories developed in legal scholarship and within COPUOS. The following analysis examines each major theory, explaining its legal or scientific rationale and the practical advantages and drawbacks it presents. Among these theories, the Interspace Theory merits particular attention, as it offers a potential synthesis of the strengths found in both spatial and functional approaches.

4.1 Spatialist Theory

The Spatialist Theory proposes a fixed altitude line as the boundary between airspace and outer space, with the Kármán line at 100 kilometers often serving as the proposed demarcation. This idea rests on classical doctrines of territorial sovereignty, which hold that states exercise complete control over the space above their territory, but such control cannot extend infinitely upward.[36] V*on Kármán's* calculations suggested that at around 100 kilometers, aerodynamic lift ceases to be sufficient for conventional flight, requiring orbital velocity for sustained movement, representing a point of transition.[37] The Fédération Aéronautique Internationale (FAI) has adopted this line for record-keeping and astronaut classification.[38] However, this transition may actually occur at altitudes as low as 80 kilometers, and technological advances might further lower or shift this boundary.[39] Other approaches set the boundary at 80 kilometers, because this corresponds to the altitude historically used by the United States to award astronaut wings and reflects where aerodynamic lift becomes negligible, or at 110 kilometers, because this accounts for variations in atmospheric density and ensures that all orbital flight paths are well above controlled airspace.

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[36] ibid 324–326.

[37] Theodore von Kármán (n 22).

[38] 'Definition of Outer Space' (Fédération Aéronautique Internationale) <https://www.fai.org/page/icare-boundary> accessed January 2026.

[39] Jonathan C McDowell (n 34).

The spatialist allows states and commercial actors to know precisely when air law ceases and space law begins, because it provides legal certainty and administrative clarity.[40] Yet, it risks being technologically obsolete as vehicles evolve. It also ignores functional realities, as some aerospace vehicles may cross such boundaries briefly but remain fundamentally aviation operations. If the international community sticks with such a rigid boundary, it risks freezing the law in a way that cannot accommodate future developments.[41]

4.2 Functionalist Theory

The Functionalist Theory suggests that the determination of legal regimes should not hinge on altitude, but rather on the nature and purpose of the activity or object involved. Under this view, an aircraft engaged in commercial aviation remains under air law, even if it ascends to altitudes traditionally associated with outer space. Conversely, an object designed for space exploration or satellite operations should fall under space law, regardless of the altitude at which it operates.[42]

This approach aligns with teleological principles in treaty interpretation, where the purpose and object of a treaty guide its application.[43] The functionalist theory is flexible and adaptable to technological innovation. It is particularly attractive for emerging industries like suborbital tourism, as these activities presently combine atmospheric flight with momentary excursions into near-space altitudes.[44] The principle of functionalism can avoid categorizing activities based solely on arbitrary altitude thresholds. However, the functionalist approach suffers from considerable drawbacks. Determining "purpose" can be subjective, leading to inconsistent interpretations by national authorities or courts. Such uncertainty complicates regulatory compliance and business planning. Furthermore, the theory fails to resolve questions of vertical sovereignty. Even if a flight is functionally "aviation," it could still traverse airspace that another state claims as sovereign territory, raising security concerns.[45]

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[40] Francis Lyall and Paul B Larsen, *Space Law: A Treatise* (Ashgate 2009) 92–94.

[41] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 327f.

[42] Paul Stephen Dempsey and Maria Manoli (n 11) 202–215.

[43] See Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1155 UNTS 331 art 31.

[44] Roy Balleste (n 5) 1048.

[45] Dean N Reinhardt (n 6) 65–140.

4.3 No Present Need Theory

The No Present Need Theory is a pragmatic stance adopted by several states and scholars. Proponents argue that, in practice, the absence of a defined boundary has not yet produced significant legal disputes requiring urgent resolution. Thus, creating a legal boundary might be premature, especially since technology and geopolitical dynamics are still evolving.[46] COPUOS reports reflect this position, concluded that no pressing practical need exists for delimitation at this time.[47] While maintaining flexibility is wise, to avoid rules that might constrain future innovation or geopolitical arrangements, this stance is not acceptable for international law. There is no reason to wait for an event or accident to occur, and then argue about the solution afterward. The absence of conflicts today does not guarantee future harmony. Commercial actors increasingly demand legal clarity for licensing, insurance, and liability issues.[48] Any continued ambiguity may provoke unilateral actions by states to protect national interests, potentially fragmenting the coherent legal regime established by the OST.[49]

4.4 Interspace-Theory[50]

The main theories mentioned before could not prevent a legal grey zone in the upper atmosphere: the region sometimes called "near space" (roughly 80–120 km altitude) lies between the highest reach of routine aircraft and the lowest stable orbits of spacecraft. This is an area neither clearly under air law nor space.[51] To address this regulatory gap, scholars have looked for analogies in other areas of international law, and maritime law provides a compelling model. Notably, the United Nations Convention on the Law of the Sea (UNCLOS) created nuanced zones between a nation's territorial waters and the open high seas. Coastal states have a contiguous zone and an Exclusive Economic Zone (EEZ) extending well beyond their 12-nautical-mile territorial sea.[52] In

[46] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20) para 116.

[47] ibid para 118.

[48] Roy Balleste (n 5) 1049.

[49] Dean N Reinhardt (n 6) 102–106.

[50] In this context, the Interspace-Theory is often referred to as Mesospace-Theory, Exclusive Economic Zone-Theory or Exclusive Utilization Space-Theory.

[51] Hao Liu and Fabio Tronchetti, 'Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model?' (n 7), 95.

[52] United Nations Convention on the Law of the Sea (UNCLOS) arts 55–57.

these intermediate zones, a state may exercise certain jurisdictional rights, such as enforcement of customs and immigration laws in the contiguous zone, or exclusive rights to exploit natural resources in the EEZ, without full sovereignty over the area. The underlying principle is that states can control and utilize adjacent international areas to a limited extent, balancing their interests with the global community's freedom. This flexible approach in maritime law, a sui generis zone that is neither purely national nor purely international, inspired space law theorists to seek an analogous solution for the height gap above sovereign airspace.[53]

The Interspace-Theory emerged from this inspiration. It was articulated in the late 2000s and 2010s by legal scholars aiming to reconcile the competing doctrines of "spatialism" and "functionalism" in delimiting outer space.[54] Drawing explicitly from the EEZ precedent, proposals argue for a *transitional zone* above national airspace. Sometimes termed an "Exclusive Utilization Space (EUS)," this zone would exist roughly between the upper limit of routine aviation and the lower reaches of orbital flight, for example, between about 50–120 km in altitude. Within this band, the underlying state would retain regulated jurisdiction over activities, without claiming sovereign territory up to the brink of outer space. In effect, a country could license and oversee what happens in the skies above it[55] for certain purposes, much as coastal states manage economic use of waters out to 200 nautical miles in their EEZ, but it could not treat that space as national airspace or exclude others outright.

This concept's intellectual lineage can be traced directly to UNCLOS. Just as UNCLOS balanced coastal state rights with high-seas freedoms, the Interspace-Idea seeks to balance state sovereignty interests with the freedom of outer space. Although there are differences between the ocean and the aerospace environments, several characteristics of the EEZ, if adequately modified, can be used as a model to shape the legal regime of near space.[56] The EEZ is considered a *sui generis* zone combining elements of both territorial jurisdiction and open commons, and this hybrid nature is

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[53] Hao Liu and Fabio Tronchetti, 'The Exclusive Utilization Space: A New Approach to the Management and Utilization of the Near Space' (n 32) 551–558.

[54] See for more references: Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 323–335.

[55] Which is far higher than today's air traffic altitudes.

[56] Hao Liu and Fabio Tronchetti, 'The Exclusive Utilization Space: A New Approach to the Management and Utilization of the Near Space' (n.32), 565-572.

precisely what is attractive for solving the airspace/outer space boundary problem.[57] In maritime history, the concept arose when nations wanted greater control over nearby fisheries and resources without extending full sovereignty over the ocean. Likewise, in the aerospace context, the surge of high-altitude vehicles and commercial uses of near space has prompted calls for a new legal category that isn't full sovereignty but isn't complete laissez-faire either, which leaves states nervous about security and a regulatory vacuum.[58] The Interspace-Theory was born from this pragmatic need by carving out an intermediate legal space.

4.4.1 Parallels to the Law of the High Seas

The proposed meso-space regime draws several clear parallels with maritime zones and the law of the high seas.

In maritime law, the high seas are open to all states, whereas coastal states have control closer to shore. Similarly, outer space is a global commons free for all, while each state has exclusive control in the airspace immediately above its territory. An intermediate near-space zone would mimic the EEZ by granting the underlying state limited jurisdiction for certain uses or regulation beyond its sovereign airspace, without negating the general freedom of outer space beyond that zone. This ensures that no state can appropriate outer space outright, yet states could manage local aerospace activities in the band above their territory.

A core feature of UNCLOS's EEZ is that the coastal state has the right to exploit and regulate resources out to 200 nautical miles, but this zone is not its sovereign territory.[59] The Interspace-Theory copies this idea. The state would have the right to authorize and regulate certain activities, such as launches, high-altitude flights, or surveillance platforms in near space, in a designated altitude band overhead, without extending its sovereignty to that region. This limited jurisdictional zone echoes the balance in maritime law: it recognizes states' interests in the adjacent international area while preserving the notion that outer space beyond remains *res communis*.[60] In

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[57] ibid 12.

[58] Kravchenko, Nataliia. 'International Legal Status and Regime of the Exclusive Economic Zone and the Open Sea: Comparative Characteristics.' ScienceRise: Juridical Science, 2020, 44-51.

[59] UNCLOS art 56.

[60] Michael W Lodge, 'The Deep Seabed' In Donald Rothwell and others (eds) *The Oxford Handbook of the Law of the Sea* (Oxford University Press 2015) 228–231.

practice, this could mean a state manages traffic and safety in the 50–120 km range above it, similar to how it manages fisheries or pollution control in an EEZ, all the while acknowledging that above the upper limit it is the wild *"high seas"* of space where all enjoy equal freedom.

High seas freedom under UNCLOS is conditioned by a duty of "due regard". States must consider others' rights when using the high seas.[61] The OST likewise requires states to conduct space activities with due regard to the corresponding interests of all other States.[62] This parallel underscores that even in a free commons, activities aren't a free-for-all; there is an expectation of responsibility and coordination. As one UN document notes, the insertion of "due regard" in the OST marked a shift away from a pure *laissez-faire* view of space towards a regime balancing competing uses, much like the evolution of high seas law.[63] A meso-space zone, if established, would likely incorporate similar due regard obligations, like requiring that a state in exercising its near-space jurisdiction must not unduly interfere with the freedom of other states' spacecraft passing through, and vice versa.[64]

The deep seabed is (...) often deemed the "common heritage of mankind," managed by international frameworks as in the International Seabed Authority for mining rights.[65] In outer space, the *common heritage* idea appears in the Moon Agreement and is frequently invoked to discuss asteroid mining or lunar resources.[66] While the Interspace-Theory mostly addresses the zone of flight operations rather than resources, the ethos behind it resonates with the common heritage concept: it seeks a collaborative framework so that near-space is used peacefully and for the benefit of all, rather than dominated by a single state. If, for instance, high-altitude spectrum or launch corridors are considered a resource, they could be allocated in a way that mirrors

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[61] UNCLOS art 87(2).

[62] Outer Space Treaty art IX.

[63] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'The "Space 2030" agenda and the global governance of outer space activities' (13 December 2017) UN Doc A/Ac.105/1166 para 49.

[64] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 334–335.

[65] UNCLOS arts 136–137.

[66] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (adopted 5 December 1979, entered into force 11 July 1984) 1363 UNTS 3 (Moon Agreement) art 11.

the cooperative management of international spaces.[67] Therefore, applying an UNCLOS-style model to space, with zones like an EEZ and cooperative management beyond, would ensure equitable and orderly development of space, preventing conflicts over orbital paths or resource extraction.

4.4.2 Application to Space Law and Governance

Adopting a maritime-inspired meso-space regime would mark a significant evolution in space law. In general, it offers a pathway to clarify the boundary question that has vexed policymakers for decades. By formally designating an altitude band as a special legal zone, states could agree on where their airspace sovereignty definitively ends and where outer space freedom fully begins. For example, if the international community agreed on a 50–120 km "near-space zone," it would implicitly define 120 km as the top of national jurisdiction and 50 km as the upper limit of traditional airspace. This would bring much-needed certainty, since continuing without any delimitation risks confusion and conflict. A meso-space framework could break the diplomatic stalemate by sidestepping the all-or-nothing approach. This pragmatic compromise does not force an absolute choice of one altitude as "the" boundary, but instead creates a buffer zone with shared characteristics.[68]

In broader space governance, implementing an UNCLOS-inspired model could encourage the development of customary law and soft-law agreements. Just as the EEZ concept began with unilateral claims by states in the mid-20th century and later was codified in UNCLOS, we may see leading spacefaring nations or international bodies start to articulate rules for near-space operations.[69] The ICAO and COPUOS have already been discussing high-altitude vehicles and suborbital flights.[70] If a few major actors were to establish national provisions recognizing a near-space zone for regulatory purposes, this could lay the groundwork for a multilateral agreement down the line.

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[67] Fabio Tronchetti, *The Exploitation of Natural Resources of the Moon and Other Celestial Bodies: A Proposal for a Legal Regime* (Martinus Nijhoff 2009) 143–158.

[68] Marshall McKellar, 'The Question of Aerospace Vehicles: In Support of Dual Legal Systems for a Dual Purpose Craft' (2017) Indian Journal of Law and Technology: Vol. 13, 47–61.

[69] Myron H Nordquist (ed), *United Nations Convention on the Law of the Sea 1982: A Commentary*, volume I (Martinus Nijhoff 1985) 110–115.

[70] Concept of Suborbital Flights: Information from the International Civil Aviation Organization (ICAO), Conference Room Paper A/AC.105/C.2/2010/CRP.9, Committee on the Peaceful Uses of Outer Space, Legal Subcommittee, Forty-ninth session (19 March 2010).

For now, no treaty explicitly covers meso-space, but the principle of not harming others and cooperating provides a legal basis that could be built upon to manage this zone. Furthermore, an Interspace regime could delineate responsibilities for traffic management and for environmental protection in a way that current space law doesn't explicitly address. By clarifying jurisdiction, it would also solidify how the *Registration Convention* and *Liability Convention* apply to objects in this zone, currently a grey area when a vehicle is in an ambiguous state between air and space.[71] Overall, the maritime analogy provides a blueprint for balancing national interests with the *res communis* nature of space: it suggests that space law can evolve by adding layers, rather than by a binary flip at an invisible line.

4.4.3 Implications for Space Tourism

One of the most immediate practical drivers for the Interspace concept is the rise of space tourism and suborbital flight. Commercial ventures like Virgin Galactic's *SpaceShipTwo* and Blue Origin's *New Shepard* carry paying passengers to the edge of space, while reaching altitudes of about 80–110 km before returning to Earth. Operators face uncertainty about which safety and technical standards apply: airline-level certification or spaceflight-level informed consent? What liability regime governs passenger injury or third-party damage – the Montreal Convention or the Space Liability Convention? These questions have concrete implications. For instance, if a suborbital tourism rocket from Country A accidentally crosses over Country B's territory during its flight, would that be an illegal airspace violation? Under the Chicago Convention, unauthorized overflight of national airspace violates sovereignty. But if at, say, 80 km altitude, the craft is considered to be in outer space, Country B could have no sovereign claim to that altitude. Such a scenario could easily lead to diplomatic disputes given the ambiguity. In fact, a suborbital vehicle traversing another nation's skies without prior permission could trigger allegations of unlawful overflight. A vehicle might be hailed as a "spacecraft" by its operator but treated as a trespassing aircraft by a foreign state.[72] This legal risk casts a shadow over future point-to-point suborbital travel and even over simple tourism hops if they stray over borders.

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[71] Convention on Registration of Objects Launched into Outer Space 1976 art II; Convention on International Liability for Damage Caused by Space Objects 1972 arts II–IV.

[72] Chicago Convention) arts 1 and 3.

A defined Interspace zone would directly address these issues by standardizing the legal treatment of suborbital tourism flights. If, for example, the world agreed that outer space legally begins at 120 km, then a vehicle peaking at 80 km remains under air law throughout, and one surpassing 120 km clearly enters space law territory. But a rigid line has downsides, as discussed. The Interspace approach instead would say: from takeoff up to, for instance 50 km, it's ordinary aviation; from 50–120 km (the meso-space band), the vehicle operates under a special regime where the launching state can exert control for safety and security, yet the activity is recognized as fundamentally international in character.[73] This could entail a hybrid licensing system: the space tourism operator obtains a license that covers both aviation requirements and spaceflight requirements in one unified framework. Crucially, other states would agree that a vehicle in the meso-space corridor above their territory is not "in" their sovereign airspace, provided it complies with whatever conditions the Interspace regime sets. The underlying coastal-state analogy means that the state below could impose some conditions, for example, requiring passing craft to adhere to designated corridors or altitudes for safety, much as ships traversing a coastal EEZ must adhere to certain navigation rules and respect resource rights. In practice, this would give space tourism companies more predictability: they could design flight paths knowing that above, say, 90 km over foreign soil, they are operating in an internationally sanctioned corridor rather than a legal no-man's-land subject to ad hoc permission.[74] It would also give passengers greater protection, as regulators could tailor safety standards for this unique travel mode. Without such clarity, operators today face a patchwork of rules and uncertainty in insurance and liability, which in turn affects investor confidence in the space tourism industry.[75] An Interspace framework would mitigate these concerns by delineating responsibilities: the launching state must ensure vehicle safety up to Interspace, and beyond that perhaps international rules on space activities apply once the vehicle crosses into outer space proper.[76]

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[73] Ram S Jakhu, 'Legal Issues Relating to the Global Public Interest in Outer Space' 2006 32 Journal of Space Law 31, 32–35.

[74] Fabio Tronchetti and Hao Liu, *Regulating Near-Space Activities: Using the Precedent of the Exclusive Economic Zone as a Model* (n 72) 563-565.

[75] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), "Report on the United Nations/China Second Global Partnership Workshop on Space Exploration and Innovation" (12 April 2023), UN Doc A/AC.105/1294, paras. 16–18.

[76] Outer Space Treaty arts I and IX.

Another aspect is national security and overflight rights. High-altitude vehicles like pseudo-satellites and even tourist craft can hover or travel over other nations, potentially conducting observations. Today, if they remain below an undefined threshold, it might be seen as illegal spying or airspace violation, whereas if considered in "outer space," it's permissible. The Interspace concept could set clear rules here: perhaps requiring permission or setting altitude buffers for foreign Interspace vehicles, analogous to how military ships may transit others' EEZ with "due regard." As noted, states are especially sensitive about objects lingering just outside their atmosphere. A cooperative regime defining permissible operations in near-space would alleviate the binary choice of either tolerating unrestricted overhead presence or asserting a right to shoot down intruders.[77]

4.5 Demarcation Based on Atmospheric Layers

Another scientific proposal advocates using the natural layers of Earth's atmosphere as a basis for legal delimitation. The boundary would be drawn where atmospheric composition or physical properties change significantly, such as the boundary between the mesosphere and the thermosphere.[78] Supporters argue that this method reflects physical reality and would be less arbitrary than a fixed altitude like the Kármán line. However, the problem remains that atmospheric layers fluctuate due to solar activity and local climatic variations. Moreover, legal clarity suffers because vehicles operating at transitional altitudes may cross multiple atmospheric layers in a single mission, undermining the predictability this approach seeks to achieve.

4.6 Demarcation Based on Aerodynamic Characteristics

Closely related to spatialist thinking is the notion of delimitation based on aerodynamic capabilities. The legal boundary would be fixed at the altitude where aerodynamic flight becomes impossible and only orbital mechanics allow sustained movement.[79] This approach has strong engineering logic, as it ties legal categorization to physical capabilities rather than arbitrary measurements. Von Kármán's original calculations for the Kármán line reflect precisely this principle. While elegant in theory,

[77] Myron H. Nordquist (ed) (n 69) 102–107.

[78] Jonathan C McDowell (n 34) 670.

[79] Theodore von Kármán (n 22).

this approach is challenged by technological advances. New vehicle designs, including those using rocket propulsion and advanced materials, increasingly push the boundary between aerodynamic and ballistic flight to newer heights. When future developments allow for aerodynamic control at altitudes above 100 kilometers under specific conditions, even this purely aerodynamic criterion may no longer be technologically robust.[80]

4.7 Demarcation According to Lowest Perigee

Some scholars have proposed delimiting outer space based on the lowest sustainable perigee of orbital flight. Under this theory, the boundary would lie at the minimum altitude at which a satellite can complete at least one orbital revolution without decaying due to atmospheric drag.[81] This proposal seeks to align legal rules with functional realities of orbital mechanics and is attractive because it directly connects the legal definition of "space activity" to physical principles. However, the theory faces practical issues. The lowest sustainable perigee depends on satellite mass, shape, and solar activity, making a universally fixed boundary difficult to define. Moreover, relying solely on perigee fails to address suborbital activities, which do not involve sustained orbits but nonetheless operate at altitudes associated with space.

4.8 Arbitrary Distance Theory

Finally, the Arbitrary Distance Theory suggests simply choosing a legal boundary at a specific altitude, regardless of physical, functional, or technological criteria, to ensure legal certainty. Such a boundary might be set at 100 kilometers, 80 kilometers, or any agreed figure. This theory's strength lies in administrative simplicity and the avoidance of complex scientific debates. However, the very arbitrariness of the approach is unacceptable, because adopting a purely arbitrary height could undermine the credibility of the legal framework,[82] leading to challenges by states whose aerospace operations fall on either side of the chosen line.

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[80] See Jonathan C McDowell (n 34) 672–675.

[81] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 328.

[82] Bin Cheng, 'Legal Regime of Air Space and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises' (n 1) 327.

In summary, the multitude of theories concerning the delimitation of airspace and outer space reflects not only differing legal philosophies but also diverse technological, commercial, and strategic considerations. While spatialist theories offer clarity, they risk technological obsolescence. Functionalist theories accommodate technological progress but invite legal uncertainty. Hybrid models like the Interspace-Theory propose compromises but require complex legal drafting and international consensus. Other scientific and pragmatic proposals attempt to ground delimitation in physical realities but confront the challenges of variability and technological change. Among these theories, the Interspace-Theory emerges as a particularly promising model, offering a potential synthesis of legal certainty and technological flexibility. Yet, without a decisive international agreement, the legal vacuum surrounding the boundary between airspace and outer space will persist, leaving aspects of sovereignty, security, and commercial enterprise in an uncertain legal limbo until the international community can agree on a delimitation.

5. Applicability of an Interspace approach to commercial space operations

The Interspace-Theory proposes a legally defined transitional zone between sovereign airspace and the domain of outer space. This concept is increasingly seen as a possible answer to the regulatory and practical problems that arise from emerging aerospace activities operating in altitudes previously regarded as legally ambiguous. The primary strength of the meso-space model lies in its ability to offer regulatory certainty without sacrificing legal flexibility. By explicitly defining a transitional zone, it can clarify jurisdictional boundaries and regulatory obligations for commercial operators, thereby reducing investment risks and encouraging innovation.[83] Moreover, it enables states to protect national security interests without resorting to unilateral claims of sovereignty over outer space, preserving the cooperative ethos of space law. Adopting such a buffer zone would allow states to exercise functional jurisdiction over certain activities, such as safety oversight and environmental protection, while respecting outer space as a global commons. This hybrid model could also help avoid the legal and political problems associated with rigid spatial boundaries, offering a pragmatic response to the dynamic nature of aerospace technology.

[83] Hao Liu and Fabio Tronchetti, 'The Exclusive Utilization Space: A New Approach to the Management and Utilization of the Near Space' (n 32).

Despite its conceptual appeal, the meso-space approach is not without significant challenges. One critical issue lies in defining the precise altitude limits of the transitional zone. Technological diversity makes it difficult to determine where airspace ends and outer space begins because the performance capabilities of aerospace vehicles vary considerably. A fixed altitude might quickly become obsolete as technology evolves. Moreover, creating an Interspace regime would require extensive multilateral negotiations and consensus-building, which have historically proven difficult within COPUOS. Some states may perceive the approach as a potential erosion of the established freedom of outer space or as a pretext for extending national jurisdiction beyond legitimate bounds.[84] Any attempt to impose an Interspace regulatory layer therefore risks creating yet another legal grey zone if the rights and obligations within this zone are not carefully and precisely defined.[85] There is also a risk that states might adopt divergent national laws governing Interspace operations, leading to regulatory fragmentation, which would undermine one of the primary purposes of creating such a regime in the first place.

While a formal treaty establishing a meso-space regime seems unlikely in the short term, initial steps could pave the way for its eventual adoption. Soft law instruments, such as guidelines or model regulations adopted under COPUOS, might serve as an interim mechanism to standardize practices across jurisdictions. Such instruments could establish principles for licensing, liability, environmental protection, and operational safety in transitional altitudes, providing at least partial legal certainty for commercial operators. Specifically, a hybrid meso-space regulatory regime might include:

- Hybrid Licensing Frameworks

Operators of vehicles crossing into meso-space could be required to obtain both aviation and space activity licenses, with clear criteria outlining which aspects of each regulatory regime apply at different mission phases. For instance, a suborbital tourism flight could be subject to airworthiness requirements under aviation law for launch and landing phases, while adhering to space law obligations regarding registration and liability once above a designated threshold altitude.

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[84] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20) para 116.

[85] Roy Balleste (n 5) 1049.

- Defined Operational Altitude Bands

The regime could establish altitude “bands” within meso-space, each subject to tailored rules. For example, operations between 50 and 80 kilometers might be treated as extended aviation, while missions between 80 and 120 kilometers could be regulated under special Interspace provisions reflecting partial space law obligations. Such stratification would allow gradual transitions between legal regimes instead of a sharp boundary.[86]

- Traffic Management Protocols

Interspace operations might be subject to mandatory flight plan submissions and coordination with national air traffic control authorities. Operators could be required to integrate their missions into existing aviation traffic management systems to avoid conflicts with high-altitude aircraft and ensure safe deconfliction.

- Environmental and Debris Regulations

Given the increasing use of Interspace for commercial purposes, regulations could impose environmental standards akin to space debris mitigation guidelines. Operators might be obligated to avoid persistent debris release, ensure safe disposal or return of vehicles, and minimize risks to lower atmospheric layers.[87]

- Surveillance and National Security Controls

Recognizing the potential use of Interspace vehicles for intelligence gathering, states can establish rules for notification, inspection rights, and prohibitions on unauthorized surveillance, thereby addressing sovereignty concerns while permitting legitimate commercial operations.

- Liability Provisions

The hybrid regime could set forth specific liability rules for damage caused by Interspace vehicles. For example, strict liability might apply for damage caused on the surface of the Earth, while fault-based liability governs collisions occurring in meso-

[86] Hao Liu and Fabio Tronchetti, ‘The Exclusive Utilization Space: A New Approach to the Management and Utilization of the Near Space’ (n 32).

[87] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) ‘Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space’ in United Nations ‘Report of the Committee on the Peaceful Uses of Outer Space’ (2007) UN Doc A/62/20.

space itself. Such provisions would integrate principles from both the Chicago Convention and the Liability Convention.

Alternatively, bilateral or regional agreements could serve as pilot programs, testing the viability of meso-space regulation in specific contexts. Ultimately, the Interspace approach remains one of the most promising avenues for addressing the delimitation problem. It acknowledges the technological and commercial realities of modern aerospace operations while striving to preserve fundamental legal principles governing both airspace and outer space. Its success will hinge on whether the international community can translate theoretical consensus into practical legal instruments capable of accommodating the diverse interests involved.

6. The Role of International law and Soft Law in achieving Delimitation

Resolving the delimitation question requires legal instruments capable of translating theoretical models into practical, enforceable rules. Among the array of legal tools available, particular attention must be given to the roles of treaties, customary international law, and the growing influence of soft law.

Soft law occupies a unique space in the hierarchy of international legal sources. Unlike treaties or customary international law, soft law instruments are not formally binding upon states, yet they often exert substantial influence. The term "soft law" encompasses a diverse array of instruments, including resolutions, declarations, guidelines, codes of conduct, and technical standards developed by international organizations or specialized bodies.[88] These documents derive their significance from the authority they command, the reputational incentives they create for compliance, and their practical utility in shaping consistent state behavior. In the context of space activities, soft law has already proven to be an influential tool. COPUOS has played a central role in developing soft law instruments that shape the conduct of states and commercial actors alike. A prominent example is the "Space Debris Mitigation Guidelines," which, though not legally binding, have been widely incorporated into national licensing regimes and operational standards. Likewise, the "Guidelines for the

[88] Bin Cheng, 'United Nations Resolutions on Outer Space: 'Instant' International Customary Law?', Studies in International Space Law (Oxford, 1997), 125-149.

Long-term Sustainability of Outer Space Activities," adopted in 2019, reflect the collective efforts of states to promote responsible behavior and mitigate risks in the increasingly congested space environment.[89]

Applying this tool to the delimitation problem, soft law could serve as an interim solution in situations where treaty negotiations have either failed to reach consensus or remain stuck in discussions. Through the development of voluntary guidelines or model regulations, soft law instruments could propose recommended practices addressing licensing, liability, safety standards, and operational protocols for activities occurring at transitional altitudes. Such instruments might, for example, encourage states to implement harmonized rules governing suborbital flights, establishing clear licensing requirements for vehicles that cross specified altitude thresholds. Furthermore, they could promote best practices to facilitate coordination between aviation and space traffic management authorities, particularly in relation to hybrid vehicles that operate across differing legal regimes, and offer guidance on environmental protection and debris mitigation measures applicable to operations conducted within meso-space altitudes. Soft law's principal strength lies in its flexibility. It enables rapid responses to technological developments, facilitates consensus-building, and allows experimentation without locking states into rigid obligations. However, its non-binding character also constitutes its chief weakness. Soft law cannot resolve fundamental sovereignty questions, nor can it compel states to resolve jurisdictional disputes. Its effectiveness depends entirely on voluntary compliance and the reputational incentives states perceive in adhering to agreed standards.[90]

Customary international law represents another possible mechanism for resolving the delimitation question. Defined as the general and consistent practice of states followed out of a sense of legal obligation, customary law is binding upon all states, regardless of whether they are parties to specific treaties.[91] It functions as a foundational pillar of international law, filling gaps left by treaty law and adapting legal rules to evolving circumstances. In principle, customary law could crystallize a boundary

[89] COPUOS 'Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space' in United Nations 'Report of the Committee on the Peaceful Uses of Outer Space Sixty-second session (12-21 June 2019) (2019) UN Doc A/74/20.

[90] Roy Balleste (n 5) 1040–1043.

[91] Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1155 UNTS 331 art 38.

between airspace and outer space if states were to converge around a consistent practice of recognizing a specific altitude or functional criterion. Historically, customary law played a decisive role in the development of both air law and maritime law. Yet, in the case of delimitation, the evidence for emerging customary norms remains weak. State practice is far from uniform, and some states informally reference the Kármán line or other altitude thresholds in domestic regulations, but few have declared these limits as binding rules of international law. The United States, for example, has historically recognized 80 kilometers as the threshold for awarding astronaut wings, but it has carefully avoided declaring this altitude as a legally binding boundary between sovereign airspace and outer space.[92] Other states, notably Russia and several developing nations, prefer to maintain flexibility, fearing that a fixed boundary could constrain future technological development or strategic interests. COPUOS documents repeatedly underscore the lack of consensus, noting that while the subject remains under discussion, the majority of states do not perceive an immediate practical need to establish a boundary.[93] Absent a clear pattern of consistent practice and *opinio juris*, customary law cannot itself, at present, supply a definitive solution to the delimitation problem. The possibility remains that customary rules might emerge in the future, especially if key spacefaring states begin to align their national legislation and regulatory practices around common altitude thresholds or functional criteria. Until such convergence occurs, however, customary law offers no immediate pathway to resolving the delimitation question.

Treaty law represents the most authoritative and legally certain mechanism for resolving the delimitation issue. Under the Vienna Convention on the Law of Treaties, states possess full freedom to negotiate and conclude agreements that define rights, obligations, and jurisdictional boundaries.[94] The historical evolution of air law and space law reflects the power of treaty-making in creating durable legal regimes, as evidenced by the Chicago Convention, the OST, and subsequent agreements. A binding treaty defining the boundary between airspace and outer space would offer unparalleled legal clarity. However, the political obstacles to such an agreement remain significant. Many states fear that committing to a fixed boundary could constrain national security

[92] Jonathan C McDowell (n 34).

[93] COPUOS 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20) para 116.

[94] Vienna Convention on the Law of Treaties art 39.

prerogatives.[95] Furthermore, the diversity of actors in today's space domain, which includes private corporations, emerging space nations, and regional alliances, complicates treaty negotiations. Achieving consensus among such diverse stakeholders on such an issue is unlikely in the near term. Thus, while a treaty remains the ideal legal instrument, practical realities suggest that it may not provide a solution in the immediate future.

Given the challenges of universal treaty-making, bilateral and regional agreements present an alternative mechanism for managing delimitation in specific contexts. Neighboring states might enter agreements to define operational rules for suborbital flights, cross-border high-altitude activities, or joint licensing regimes for reusable launch systems. Such agreements can tailor solutions to local geopolitical, commercial, and technological circumstances. However, the proliferation of regional arrangements risks creating a fragmented legal landscape. Divergent regional rules could undermine the principle of uniformity in space law and create new jurisdictional conflicts. While bilateral solutions may serve immediate operational needs, they cannot fully substitute for a universal framework capable of addressing the global nature of space activities. In this regard, COPUOS has long served as the principal institutional forum for deliberation on the delimitation problem. Its Legal Subcommittee has maintained the topic on its agenda for decades, which highlights both the importance and the political sensitivity of the issue.[96] Although COPUOS has not achieved consensus on a boundary, it remains the key venue for dialogue, knowledge exchange, and soft law development. The Committee's success in producing soft law instruments, such as the Space Debris Mitigation Guidelines and the Guidelines for the Long-term Sustainability of Outer Space Activities, illustrates its potential to generate consensus on complex legal topics. While these instruments lack binding force, they often serve as precursors to later treaty provisions or customary norms. Continued engagement within COPUOS may gradually narrow the divergence of views and could support in finding a solution to the problem of delimitation.

Given the political obstacles to treaty-making and the incomplete development of customary law, a hybrid strategy may represent the most practical way forward.

[95] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20) para 116.

[96] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20) para 118.

Under such an approach, states could adopt soft law guidelines that establish regulatory standards for meso-space operations while leaving open the possibility of future codification into binding treaties. Simultaneously, bilateral and regional agreements could serve as laboratories for legal innovation, offering models that might eventually inform broader international practice. Such a strategy aligns with the adaptive nature of space law itself, which has historically developed through the gradual layering of soft norms, customary practice, and formal treaties. The current legal vacuum cannot persist indefinitely without risking regulatory fragmentation and commercial uncertainty.

7. Current applicability

Several real-world examples illustrate how the absence of a defined boundary generates operational confusion, regulatory gaps, and geopolitical tensions. A closer examination of legal practice in different jurisdictions further reveals the divergent approaches adopted by states and the profound implications for the burgeoning commercial space industry.

In the United States, the regulatory approach to activities straddling the boundary between air and space is marked by the pragmatic use of existing legal frameworks. The Federal Aviation Administration (FAA) assumes responsibility for licensing commercial space launches under the Commercial Space Launch Act, while simultaneously regulating high-altitude atmospheric flights through its aviation division.[97] However, the FAA's jurisdictional reach into near-space activities remains legally ambiguous. For example, suborbital tourism vehicles are licensed under the FAA's Office of Commercial Space Transportation, even though their trajectories often remain below traditional orbital altitudes.[98] This dual licensing framework reflects a functional approach but also underscores the absence of statutory clarity on whether suborbital operations fall definitively under aviation or space law. The practical consequences are significant. Operators face uncertainty regarding applicable safety standards, liability regimes, insurance obligations, and passenger protections. In recent years Washington has reiterated that "there is no need to seek a legal definition or delimitation for outer space," arguing that practice under the Outer Space Treaty and

[97] Federal Aviation Administration (FAA), "Commercial Space Launch Act" 51 U.S.C. § 50901 et seq. (2010).

[98] Roy Balleste (n 5) 1045–1049.

other instruments suffices and that a fixed line could create unnecessary legal and operational constraints.[99] This stance preserves strategic flexibility for national security space, including military space support to terrestrial operations, accommodates dual-use aerospace activity such as hypersonic research, suborbital human spaceflight, and reduces regulatory friction for commercial ventures whose trajectories traverse the high atmosphere before achieving space-like profiles.[100] U.S. defense and policy literature also emphasizes tailoring deterrence and freedom of action across the atmosphere–space continuum, which is another reason to avoid a boundary that adversaries could exploit or use to contest operations.[101]Russia has consistently maintained that outer space begins where atmospheric flight is no longer physically sustainable, a position influenced by its emphasis on national security and military considerations. Russian doctrine often interprets high-altitude flights, even those conducted for commercial purposes, through the lens of strategic defense.[102] Despite Russia's robust state control over aerospace activities, its national legal framework does not codify a precise altitude boundary separating airspace from outer space. This ambiguity preserves flexibility but simultaneously introduces operational risk for foreign commercial actors. Any activity perceived as intruding into Russian sovereign airspace could provoke regulatory action, interception, or diplomatic protest. The geopolitical consequences of such incidents, particularly in an era of heightened international tension, cannot be underestimated. The Russian Federation's contemporary submissions and interventions portray delimitation as an issue on which the international community lacks the "necessary conditions" for agreement.[103] In parallel, Moscow's broader space-security diplomacy prioritizes legally binding constraints on space weaponization, but without tying those

[99] U.S. Mission Unvie, '2022 COPUOS LSC – U.S. on the Definition and Delimitation of Outer Space and the Character and Utilization of the Geostationary' (U.S. Mission to International Organizations in Vienna, 29 March 2022) <http://vienna.usmission.gov/2022-copuos-lsc-u-s-on-the-definition-and-delimitation-of-outer-space/>.

[100] '85. U.S. Statement, Definition and Delimitation of Outer Space and the Character and Utilization of the Geostationary Orbit, Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space at its 40th Session in Vienna from April' (U.S. Department of State) <https://2009-2017.state.gov/s/l/22718.htm> accessed 1 October 2025.

[101] Dennis M Rice, *Deterrence and Space Strategy: A Framework from the Study of History and Theory* (Air University Press 2023) 4–5.

[102] Dean N Reinhardt (n 6) 98–102.

[103] Committee on the Peaceful Uses of Outer Space 'Matters relating to the definition and delimitation of outer space: replies of the Russian Federation' (17 March 2014) UN Doc A/AC.105/C.2/2014/CRP.6 para 12.

security goals to a numerical altitude limit for delimitation.[104] In geopolitical terms, this security-first caution makes a fixed boundary unattractive unless it demonstrably enhances Russia's freedom to operate and defend.

China's public diplomacy at the U.N. stresses peaceful use, opposition to weaponization, and support for new legally binding instruments on space security, without stating a specific numeric boundary at COPUOS.[105] Beijing has endorsed keeping delimitation on the agenda while encouraging continued study rather than codifying an altitude.[106] As a rapidly advancing space power, China benefits from managed ambiguity that does not foreclose future aerospace technologies. It can be noted that the absence of a fixed boundary enables major powers to keep doctrinal and technological pathways open.

Despite different rhetoric, the major space superpowers object a clear boundary for the following reasons: Military-operational flexibility across the "aero-space" seam, since a rigid altitude could become a justiciable trigger point for sovereignty claims or use-of-force narratives, second technology hedging for emerging vehicles because locking an altitude today may misfit tomorrow's capabilities, and lastly it's about regulatory leverage in great-power competition: ambiguity preserves bargaining space, while a fixed line could inadvertently advantage rival concept-of-operations.

Australia presents an interesting case of a middle-power jurisdiction attempting to address near-space operations through legislative innovation. The Space Activities Act 1998 and its subsequent amendments regulate commercial space activities originating in Australia or involving Australian entities.[107] Australian authorities have adopted a cautious approach, generally aligning licensing thresholds with altitude parameters similar to the Kármán line. Australia's regulatory environment reflects an awareness of the commercial opportunities and national security risks associated with near-space activities. However, the absence of a defined boundary remains problematic.

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[104] Statement by the Head of the Russian Delegation K. V. Vorontsov to the First Committee of the 77th Session of the UN General Assembly 12 September 2022.

[105] 'Written Statement of the Chinese Delegation at the Thematic Discussion on Outer Space at the First Committee of the 76th Session of the UNGA' (Permanent Mission of the People's Republic of China to the UN, 12 October 2021) <https://un.china-mission.gov.cn/eng/chinaandun/disarmament_armscontrol/unga/202110/t20211023_9613793.htm>.

[106] Group of 77 and China, 'Statement … 64th Session of the Legal Subcommittee of COPUOS' 16 May 2025.

[107] Australia, Space Activities Act 1998 (Cth), p. 8.

The European Union has yet to produce a harmonized legal framework for the delimitation of airspace and outer space. Instead, member states retain their own national regulations, leading to a fragmented landscape.[108] This lack of uniformity poses significant challenges for commercial operators within the EU. The EU has expressed interest in developing more coordinated policies, particularly through agencies like the European Space Agency (ESA) and the European Space Policy Institute (ESPI), but progress remains incremental. As ESPI reports note, legal fragmentation threatens to undermine Europe's competitiveness in the emerging commercial space sector, as investors seek regulatory certainty.[109]

Thailand has refrained from taking a decisive position on this matter. While it reported to the UNCOPUOS back in 2009 that it had no national law to address the question of delimitation, it nevertheless emphasized that the matter was a "classic legal issue that needs urgent clarification."[110] Over the following years, the kingdom's stance shifted. In 2016, Thailand expressed the view that outer space should be defined "in accordance with aerospace operations," and at that stage "should not rely on geographical considerations," while remaining open to "future modifications."[111] What at first sounded like a support for a functionalist approach gradually gave way to a more spatialist orientation. By 2022, Thailand issued a statement that delimitation "has to be clear about the altitude above sea level" and proposed that "the appropriate altitude should be 100 ±10 km above sea level."[112]

In more recent general statements to the Legal Subcommittee, Thailand has placed emphasis on domestic space-law developments and broader principles such as peaceful use and equitable access, without contradicting its 2022 altitude indication.

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[108] European Space Policy Institute, Towards a European Approach to Space Traffic Management, ESPI Report 71 (Vienna: ESPI, 2022), 22.

[109] ibid 23.

[110] United Nations Office for Outer Space Affairs (UNOOSA) 'National Legislation and Practice Relating to the Definition and Delimitation of Outer Space: Note by the Secretariat, Addendum' (11 January 2010) UN Doc A/AC.105/865/Add.6 2 (Thailand reply, 11 November 2009).

[111] UNOOSA 'Definition and Delimitation of Outer Space: Views of States Members and Permanent Observers of the Committee: Note by the Secretariat, Addendum' (18 January 2017) UN Doc A/AC.105/1112/Add.2 2 (Thailand reply, 2 November 2016).

[112] Chukeat Noichim, Assistant Professor, School of Law, Mae Fah Luang University, 'Thailand's Statement Agenda Item 7(a): The Definition and Delimitation of Outer Space' (Sixty-First Session of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, 30 March 2022).

These later interventions have not added new specifics on where exactly to draw the line, but they remain consistent with Thailand's underlying concern for predictability and sustainability in the face of new commercial activities. In conclusion, Thailand's official position, as communicated to UNCOPUOS, is one of cautious pragmatism: it has refrained from advocating a rigid and universally binding demarcation, yet it has acknowledged the need for greater clarity.

Against this background, the meso-space approach appears particularly suitable for Thailand's perspective. On the one hand, it reflects the country's earlier support for a functionalist framework by allowing the regulation of activities based on their operational nature rather than a single rigid boundary. On the other hand, the meso-space approach incorporates Thailand's more recent willingness to accept a relatively fixed altitude reference, such as around the 100 km mark, while avoiding an overly precise and politically contentious line. The concept of a transitional "meso-space" zone thus provides a pragmatic compromise that aligns with Thailand's dual concerns: predictability for operators and regulators, and flexibility for the international community to adapt rules as space activities evolve. For a country like Thailand, which is in the process of developing its own national space law and assessing spaceport feasibility, adopting the meso-space approach could offer legal certainty for domestic stakeholders without forcing a premature or rigid international settlement.

8. Policy recommendations and outlook

The preceding chapters have demonstrated that the absence of a clear delimitation between airspace and outer space presents profound challenges for legal certainty, commercial activity, and geopolitical stability. The task now is to explore specific pathways for addressing these challenges. Policy solutions must balance technological realities with legal principles, respecting the sovereignty of states while enabling sustainable and innovative space operations. Although a single, universally accepted solution remains elusive, several practical recommendations emerge for states, private actors, and the broader international legal community.

For national governments, the primary challenge is reconciling the principle of state sovereignty with the freedoms of outer space. States should consider adopting hybrid regulatory regimes that recognize the transitional nature of near-space activities. Such regimes might include altitude-based bands, as proposed under the Interspace-

Theory, where national jurisdiction is partially retained for safety, security, and environmental protection without asserting full territorial sovereignty. Governments should also strive for regulatory harmonization at the regional and international levels. Fragmented national regulations, as seen within the European Union, create uncertainty for operators and risk undermining the competitive potential of domestic aerospace industries. Regional organizations such as ESA and legal fora like COPUOS could serve as platforms for aligning licensing standards, liability rules, and technical requirements. Moreover, states should enhance transparency and notification practices for near-space operations, particularly those involving high-altitude pseudo-satellites or suborbital vehicles. Establishing protocols for prior notification, data sharing, and operational deconfliction could mitigate national security concerns and reduce the risk of misinterpretation or escalation.

Private companies operating at the edge of space must navigate a complex legal landscape marked by uncertainty. To mitigate risk, commercial actors should engage proactively with regulators, participating in consultations and offering technical insights that can inform regulatory development. Industry input is crucial to crafting realistic rules that accommodate operational realities without imposing undue burdens.[113] Operators should also adopt voluntary compliance with soft law guidelines, even where such standards lack binding force. Demonstrating adherence to international best practices in areas like debris mitigation, safety protocols, and environmental protection can bolster the legitimacy of commercial missions and facilitate smoother relations with regulators. Moreover, companies would benefit from investing in legal contingency planning. Given the possibility of jurisdictional disputes or divergent interpretations of applicable law, operators should ensure that contracts, insurance policies, and risk management strategies explicitly address scenarios where the legal classification of operations remains ambiguous.

At the international level, there is a pressing need for sustained dialogue and incremental progress. COPUOS remains the primary institutional venue for discussing delimitation, yet decades of debate have yielded no definitive boundary. While this reflects geopolitical caution, the rapid pace of technological change and commercial investment demands at least partial solutions.[114] One avenue is the adoption of soft

[113] Roy Balleste (n 5) 1045–1049.

[114] United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) 'Report of the Legal Subcommittee on its Fifty-Eighth Session, held in Vienna from 1 to 12 April 2019' (n 20).

law instruments as interim measures. COPUOS could develop non-binding guidelines or model regulations governing activities in transitional altitudes. Such instruments could establish principles for licensing, liability, surveillance rules, and safety standards without imposing permanent boundaries. Soft law has already proven effective in shaping state behavior in space debris mitigation and long-term sustainability. Furthermore, we should continue examining how customary international law might evolve to fill the current legal vacuum. While no clear customary norm exists yet for the delimitation of space, consistent practice by leading spacefaring nations, if combined with clear expressions of legal obligation, could eventually crystallize a rule recognized by the international community.

9. Conclusion

The question of where airspace ends and outer space begins remains one of the most profound and unresolved issues in international law. As this paper has shown, the absence of a universally agreed boundary is not merely an academic curiosity but a problem with significant practical implications for state sovereignty, national security, and the rapidly growing field of commercial space activities. Throughout the evolution of air law and space law, distinct legal regimes have emerged, each grounded in fundamentally different principles. This conceptual divergence has left a legal vacuum in the altitudes where modern aerospace vehicles now operate.

As documented in this paper, numerous theories have been proposed to resolve the delimitation problem, ranging from rigid spatial boundaries to functional approaches. Yet none of these solutions has achieved universal acceptance. Among the various proposals, the Interspace or Meso-space Theory emerges as a particularly compelling candidate. By creating a transitional legal zone, it seeks to reconcile the sovereignty concerns of states with the freedom of outer space, offering a pragmatic pathway forward. However, as the analysis has shown, even this innovative approach faces significant challenges, not least the difficulty of defining precise altitude limits and securing international consensus.

Despite decades of debate, the political reluctance to fix a boundary remains rooted in geopolitical considerations and the desire of states to maintain strategic flexibility. Yet technological advancements increasingly pressure the legal system to adapt. The path toward resolution will likely be incremental. While a binding treaty

remains the ideal mechanism for achieving legal certainty, the prospects for such an agreement in the near term are slim. Instead, progress may emerge through soft law instruments, bilateral and regional agreements, and gradual convergence in state practice that could one day crystallize into customary international law. Ultimately, resolving the delimitation issue is essential not only for legal clarity but for ensuring the sustainable and peaceful development of human activities in near space. It is a problem that sits at the intersection of sovereignty, security, and technological innovation. The international community must find ways to reconcile these competing imperatives, crafting legal frameworks capable of supporting both state interests and the flourishing of private enterprise.

As this paper concludes, the boundary between airspace and outer space is not merely a line in the sky. It represents a frontier in law as much as in science, a frontier whose resolution will shape humanity's next great chapter beyond Earth. It is the task of the international community to ensure that the legal architecture erected at this boundary reflects both the principles of justice and the practical realities of the twenty-first century.