THE DEFINITION AND DELIMITATION OF OUTER SPACE: THE PRESENT NEED TO DETERMINE WHERE "SPACE ACTIVITIES" BEGIN

by

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SYNOPSIS

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ABSTRACT

In air law, it is well established that a State has sovereignty over its airspace. In space law, it is well established that a State has no sovereignty over any part of outer space. There is, however, no international legal boundary or rule that distinguishes airspace from outer space, nor is there a single accepted scientific distinction. While this fact does not seem to have hindered the development of space activities since the launch of Sputnik, the difficulties with the lack of delimitation are coming sharply into focus, particularly with the emergence of significant "near space" activities, such as suborbital flight and high altitude ballooning. At this point, the lack of a distinction between air space and outer space could lead not only to conflicts between governments regarding the exercise of sovereignty, but could also significantly hamper the development of commercial near space activities, given inconsistencies between jurisdictions regarding which set of rules will apply.

This article discusses the history of the question, the implications for international space and air law, the current status of law and regulation in a few jurisdictions that are grappling with the issue, the political and technical considerations of the problem, and some suggestions for resolving it. Though there is currently a lack of political consensus about whether or not defining the limits of air and space law is necessary or even helpful, there is a present need to address the issue before it becomes a crisis. It is at least important to ensure that the discussion remains part of public discourse as relevant new technologies continue to develop.

RÉSUMÉ

En droit aérien, il est bien établi qu'un État a la souveraineté sur l'espace aérien au-dessus de son territoire. En droit de l'espace, le principe de la souveraineté n'est pas reconnu. Un État ne possède aucune autorité sur l'espace extra-atmosphérique au-dessus de son territoire. Il n'existe actuellement aucune limite juridique au niveau international qui démarque l'espace aérien de l'espace extra-atmosphérique, ni de consensus scientifique sur cette question. Bien que cette réalité ne semble pas avoir empêché le développement des activités spatiales depuis le lancement de Spoutnik, il semble que l'absence de délimitation entraîne de plus en plus de difficultés, et ce, particulièrement avec l'émergence d'activités dans l'environnent circumterrestre, tels que les vols suborbitaux et les ballons stratosphériques. À cet égard, l'absence de distinction entre l'espace aérien et l'espace extra-atmosphérique pourrait conduire non seulement à des conflits entre gouvernements quant à l'exercice de leur souveraineté, mais pourrait également gêner le développement des activités commerciales dans l'environnement circumterrestre, compte tenu des divergences entre les juridictions quant aux règles qui seront applicables.

Cet article traite de l'historique de cette question, ses implications pour l'espace international et pour le droit aérien ainsi que l'état actuel du droit dans quelques pays qui sont aux prises avec cette dernière. Il examine d'autant plus les implications politiques et techniques de cette question et propose quelques suggestions pour y répondre. Bien qu'il n'existe actuellement aucun consensus politique quant à la nécessité, ou même l'utilité, d'une délimitation entre le droit aérien et l'espace extra-atmosphérique, la question doit être abordée maintenant avant qu'une crise ne se produise. Dans tous les cas, il est important de veiller à ce que cette question demeure d'actualité au fur et à mesure que de nouvelles technologies se développeront.

KEYWORDS

Boundary, delimitation, suborbital, high altitude ballooning, harmonisation, air law, space law, near space, innocent passage, commercial space

I. ISSUE: WHY THERE IS A "PRESENT NEED"

A. EARLY SPACE ACTIVITIES

The Outer Space Treaty and all other international space law conventions are silent as to where outer space begins,[1] and "[n]o rule of conventional or customary international law defines where airspace ends and outer space begins".[2] In 1972, Judge Manfred Lachs of the International Court of Justice asked the following questions:

> (1) where are the frontiers of outer space; and
> (2) given that said frontiers are not yet established, is there any real dilemma in their absence?[3]

The first question became relevant in 1959 with the launch of Sputnik, and was not treated with urgency.[4] In the ensuing decades, there has been a reluctance to define the boundaries of space for fear that too miserly a limit would restrict the development, use and exploration of space. Further, it was deemed desirable to wait until technology had evolved sufficiently to both demonstrate the need for a limitation, and provide a better understanding of where an appropriate limit should be set.

It is the contention of this article that given the accelerated contemporary development of emerging aerospace and technologies, many of which utilise near space for their activities, and a desire to foster continued commercial development of space, the time has come to find an agreeable solution to the question of the inner frontier of outer space, and the outer frontier of airspace.

Issues of climate change and the global environment, questions of public safety with regard to emerging aerospace activities, military and strategic needs, and the benefits of a "predictable and consistent global

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[1] *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205, 18 UST 2410, TIAS No 6347, 6 ILM 386 (entered into force on 10 October 1967) [*Outer Space Treaty*]; Stephen Gorove, "Interpreting Article II of the Outer Space Treaty" (1969) 37:3 Fordham L Rev 349.

[2] Ram S Jakhu, Tommaso Sgobba & Paul Stephen Dempsey, eds, *The Need for an Integrated Regulatory Regime for Aviation and Space* (New York: Springer, 2011) at 57.

[3] Manfred Lachs, *The Law of Outer Space: An Experience in Contemporary Lawmaking* (Leiden: Martinus Nijhoff, 2010) at 53-54.

[4] *Ibid* at 53.

regulatory regime" are all key factors pointing to a present need for demarcation.[5] The critical element of the question regarding delimitation is national security.[6] "It is a trite observation that there are significant differences between the legal status of airspace and that of outer space".[7] While exclusive State sovereignty is guaranteed in airspace,[8] outer space is free for the use of all States.[9] The obvious implication is that the area of outer space above any line of demarcation could be utilised by States for a variety of both civil and military purposes that could threaten the national security of a State. Early space activities were conducted utilising "State aircraft", which, pursuant to Article 3 of the Chicago Convention of 1944, are exempt from regulation by the International Civil Aviation Organization (ICAO), a specialised agency of the UN. Thus, although early space activities necessarily involved passage through airspace, ICAO did not have the competence to exert jurisdiction over any such activities regardless of whether they took place in air space or outer space.[10]

Further, the uncertainty of where airspace ends and outer space begins creates a potential regulatory void in safety and navigation, which, in turn, creates a risk of collision with aircraft. Regulatory uncertainty inherently chills private sector investment.

The regulation of high altitude ballooning[11] as an air or space activity has brought a renewed sense of urgency to this question. Such activities, which will take place in the 21-45 kilometre range, implicate a much lower zone of near space than traditional suborbital aerospace activities, and thus could potentially set a lower bound for the conduct of space activities. It is only appropriate that balloons be a spurring force with regard to deciding questions of space law, as they were integral to the early formation of law regarding air space.[12]

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[5] Joseph N Pelton, "Beyond the Protozone: A New Global Regulatory Regime for Air and Space", paper prepared for the forum on Air and Space Law, 6 June 2013 at 1-2 [unpublished; on file with author].

[6] Lachs, *supra* note 3 at 55.

[7] Gbenga Oduntan, *Sovereignty and Jurisdiction in the Airspace and Outer Space* (New York: Routledge, 2012) at 283.

[8] *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295, ICAO Doc 7300/6, art 1 (entered into force 4 April 1947) [*Chicago Convention*].

[9] *Outer Space Treaty*, *supra* note 1, art I.

[10] Jakhu Sgobba & Dempsey, *supra* note 2 at 59.

[11] "High Altitude Ballooning History", online: World View <http://worldviewexperience.com/history/>.

[12] Francis Lyall & Paul B Larsen, *Space Law: A Treatise* (Burlington, Vt: Ashgate Publishing, 2009) at 156-157.

B. THE EVOLUTION OF THE BOUNDARY QUESTION

Given that the boundary question is one of the oldest issues in space law, it is not surprising that it has evolved through several permutations and potential solutions. "The legal instinct to delimit and demarcate is so strong that to ignore its imperative nature will be to completely disregard the impetus for much of the occurrence of international behavior as practiced within the overarching scope of sovereignty and jurisdiction".[13] Unfortunately, contrary to popular belief, there is no scientific or technical approach that justifies the creation of a boundary based on characteristics of the atmosphere;[14] the "notion of a 'boundary' is simply a humanly conceived constraint".[15] Thus, we must look for rationale elsewhere to the determination of such a boundary.

"[B]etween 1957 and 1960 alone the proposals made ranged from 20 to 1,500,000 kilometres".[16] An overview of approaches to the delimitation question can be found in two documents of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) dating back to the 1970s.[17] There have been two primary schools of thought with regard to this issue:

(1) the *functionalist approach*, which maintains that the nature of the activity rather than the location of the activity should be the determinant; and
(2) the *spatialist approach*, which proposes setting a measurable physical boundary.[18]

The problem with functionalist approach, however, is the assumption that objective assessments can be made regarding which activities qualify as air or space activities.[19] This problem worsens as new and emerging technologies pose new ambiguities. Near space, the primary area in question, falls between approximately 20 and 100 kilometres, and

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[13] Oduntan, *supra* note 7 at 19.

[14] S Neil Hosenball & Jefferson S Hofgard, "Delimitation of Air Space and Outer Space: Is a Boundary Needed Now?" (1986) 57 U Colo L Rev 885 at 889.

[15] TJF Pavlasek & Shantnu R Mishra, "On the lack of physical bases for defining a boundary between air space and outer space" (1982) VII Ann Air & Sp L 399 at 413.

[16] Oduntan, *supra* note 7 at 309.

[17] UNCOPUOS, *The Question of the Definition and/or Delimitation of Outer Space,* UN Doc A/AC.105/C.2/7 (1970), Addendum UN Doc A/AC.005/C.2/7 Add. 1.

[18] Paul Stephen Dempsey, *Public International Air Law* (Montreal: McGill University, 2008) at 741-764.

[19] Hosenball & Hofgard, *supra* note 14 at 888.

is a range in which a variety of emerging activities are likely to take place.[20]

As the term "space object" is not specifically defined in any of the UN space treaties, except to say that such objects include their component parts, this term does not help to classify objects for the purposes of a functionalist approach.[21] Therefore, "[o]ne wonders…whether there are objects launched into outer space that are not 'space objects', and whether the two expressions 'space objects' and 'objects launched into outer space' are in fact coterminous".[22]

Among the spatialist approaches, one theory is that States could exercise sovereignty over the airspace above their territories up to the point where they could maintain "effective control".[23] Most States, however, do not possess the technology, military expertise or resources to exercise any control over their air space, or even to detect intrusions into the area they would seek to control.[24]

The aerodynamic lift theory would hold that outer space should begin at the point above which a craft can no longer maintain aerodynamic lift from the reactions of the atmosphere upon its surfaces. As foreseeable civil aviation operations are not expected to exceed 100-130 kilometres, it has been proposed that the boundary be established in that range.[25] It is significant to note, however, that beyond the von Karman line, at 100 kilometres, "a vehicle would have to fly faster than orbital velocity in order to derive sufficient aerodynamic lift from the

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[20] Michael J Strauss, "Boundaries in the Sky and a Theory of Three-Dimensional States" (2013) 28:3 J Borderlands Stud 369 at 371.

[21] *Outer Space Treaty*, *supra* note 1; *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187, 24 UST 2389, 10 ILM 965 (entered into force 1 September 1972), art I(d) [*Liability Convention*]; *Convention on Registration of Objects Launched into Outer Space*, 14 January 1975, 28 UST 695, 1023 UNTS 15 (entered into force 15 September 1976), art I(b) [*Registration Convention*]; *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space*, 22 April 1968, 672 UNTS 119, 19 UST 7570, TIAS No 6599, 7 ILM 151 (entered into force 3 December 1968); *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, 18 December 1979, 1363 UNTS 3 (entered into force 11 July 1984); Bin Cheng, *Studies in International Space Law* (Oxford: Clarendon Press, 1997) at 464.

[22] Cheng, *supra* note 21 at 493.

[23] *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v United States of America)*, [1986] ICJ Rep 14 at para 115.

[24] Oduntan, *supra* note 7 at 310.

[25] UNCOPUOS, *Report of the Legal Subcommittee on its forty-ninth session, held in Vienna from 22 March to 1 April 2010*, UN Doc A/AC.105/942 at 29 [*Report of the Legal Subcommittee*].

atmosphere to stay aloft".[26] This 100-kilometer line has been a widely discussed potential boundary. Unfortunately, this type of delimitation is subject to change based on the development of new technology.

The lowest point of orbital flight theory rests on the principle that the boundary should be demarcated such that space begins at the lowest possible satellite perigee, which has been suggested to fall somewhere between 70 and 160 kilometres.[27] Likewise, this can change with technology.

The customary practice of States is that the area where artificial satellites orbit denotes outer space, and thus outer space extends down to at least the lowest perigee of such satellites; however, this does not create any assumptions regarding the end of airspace.[28] This practice would seem to imply, however, that outer space begins at an altitude as low as between 70 and 160 kilometres.

Fundamentally, "[s]cientific considerations are merely necessary to arrive at a suitable legal demarcation which would have a concrete and sensible basis, and around which the consensus of states can be built".[29] Unfortunately, to date, the UNCOPUOS has been unable to reach consensus on the boundary issue.[30] Some States have been reluctant to adopt a clear boundary out of concern for limiting their freedom of action.[31]

C. EMERGING SPACE ACTIVITIES

In 1972, Judge Lachs wrote: ”delimitation would offer clear advantages. It would prevent the misunderstanding or even friction to which uncertainty tends to give rise, facilitate international cooperation”. [32] In the ensuing decades, the emergence of new technologies and space activities have increased the potential for such

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[26] NASA, "Schneider walks the walk", online: NASA <http://www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html>.

[27] Oduntan, *supra* note 7 at 306.

[28] Jinyuan Su, "The Delimitation Between Airspace and Outer Space and the Emergence of Aerospace Objects" (2013) 78 J Air L & Com 355 at 360.

[29] Oduntan, *supra* note 7 at 284.

[30] Jakhu, Sgobba & Dempsey, *supra* note 2 at 54.

[31] Brian C Weeden & Tiffany Chow, "Taking a common-pool resources approach to space sustainability: A framework and potential policies" (2012) 28 Space Pol'y 166 at 168.

[32] Lachs, *supra* note 3 at 55.

misunderstanding and friction, as well as the creation of a patchwork system based on national regulations that creates uncertainty and ambiguity, and therefore chills growth of commercial space activities. Such emerging activities include the development of high altitude platforms, space tourism, supersonic and hypersonic transportation, military and strategic applications, dark sky stations for a variety of activities, and trans-oceanic robotic transport.[33]

Suborbital activities, such as those proposed by Virgin Galactic, Blue Origin, and Swiss Space Systems, among many others, is one significant area of uncertainty. The key difference between orbital and suborbital space travel is that orbital velocity is not achieved during suborbital spaceflights, which typically climb to an altitude of about 100km.[34] To achieve orbital spaceflight, the craft must achieve a velocity enables it to follow a path consistent with the curvature of the Earth, thus preventing the craft from being pulled back to Earth as a result of the Earth's gravitational force.[35]

It is arguable that suborbital flights, in addition to orbital flights, would fall within the purview of space law.[36] Under the functionalist approach, when a craft is considered to be a space object, space law would presumably apply to it for the entire duration of its journey. Likewise, it is possible that air law would be deemed applicable to an object designated as an aircraft, regardless of its location,[37] as long as it meets the criteria specified in the definition of aircraft in the Annexes to the Chicago Convention.[38] Aerospace objects, which travel through airspace and outer space seamlessly, are generally over 7,000 kilometres away from their landing strips when they descend to a 96 kilometre altitude. Thus, aerospace objects would be likely to traverse the airspace of another State if the boundary were indeed to be set around the 100 kilometre point.[39] While classifying suborbital and certain other non-

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[33] Pelton, *Protozone, supra* note 5 at 6.

[34] Tanja Masson-Zwaan & Stephen Freeland, "Between Heaven and Earth: The Legal Challenges of Human Space Travel" (2010) 66 Acta Astronautica 1597 at 1599.

[35] *Ibid* at 1599.

[36] Jakhu, Sgobba & Dempsey, *supra* note 2 at 57.

[37] *Ibid* at 58.

[38] ICAO, (2003) 5 International Standards and Recommended Practices: Annex 7 to the Convention on International Civil Aviation—*Aircraft* Nationality and Registration Marks, Definitions:

> Aircraft: Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the Earth's surface.

Ibid at 1.

[39] Su, *supra* note 28 at 91.

orbital flights as aviation may seem appealing, it is worth noting, for instance, that "the X-15 rocket plane can reach altitudes of up to 175 kilometres",[40] further confusing the situation. The advent of point-to-point suborbital travel will remove suborbital flight from what is arguably solely a domestic arena and bring it onto the international stage, where a line of demarcation would serve to provide significant assistance in classifying such activity.

Near space vehicles which can remain stationary and conduct activities in space are divided into free-floating balloons, steered free-floaters, and manoeuvring vehicles.[41] Such vehicles have distinct military implications, including "command, control, communications, intelligence, surveillance, reconnaissance (C3ISR), boost phase and terminal phase interception of missiles, and even prompt global strike missions".[42] As these craft are "based on flight theories distinct from purely aerodynamics and astrodynamics",[43] it is difficult to characterise them as clearly falling either within the purview of air law or space law. These vehicles could revolutionise access to the most relevant areas of outer space to study climate change and formulate mitigation strategies, and thus encouraging their development and use should be a priority.[44] A clear boundary between air space and outer space will no doubt facilitate the development of such vehicles.

As mentioned above, balloon systems are a particular area of interest, and are being pursued by both commercial and State actors. NASA's ultra-long duration balloon has been tested to an altitude of 41.5 kilometres.[45] World View Enterprises is scheduled to begin commercial "space flights" utilising their balloon that ascends only to around 30 kilometres. [46] For the purposes of safety and regulation, the United States' Federal Aviation Administration (FAA) is regulating this vehicle as a spacecraft, despite the low altitude it will achieve.[47] While there may

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[40] Hosenball & Hofgard, *supra* note 14 at 890.

[41] Su, *supra* note 28 at 90-91.

[42] *Ibid* at 91.

[43] *Ibid*.

[44] *Ibid* at 92.

[45] Dean N Reinhardt, "The Vertical Limit of State Sovereignty" (2007) 72 J Air L & Com 65 at 95, citing "Giant NASA Balloon Lifts Off From Esrange Space Center", online: Space Mart <http://www.spacemart.com/reports/GiantNASABalloonLiftsOffFromEsrangeSpaceCenter.html>.

[46] Brian Dodson, "World View Enterprises near-space balloon flights to begin in 2016", *Gizmag* (24 October 2013), online: Gizmag <http://www.gizmag.com/space-tourism-balloon-world-view/29510/>.

[47] "WVE FAA Announcement", online: World View

be sound regulatory and practical – market-driven – reasons for this decision, it could have significant implications on the delimitation of outer space.

Additionally, Tethered Satellite Systems, such as the Italian system utilised with the former US Space Shuttle programme, can be used to lower and drag satellites for temporary use with an orbital vehicle. In 1986, it was predicted that such systems could be lowered up to 100 kilometres and used at altitudes as low as 90 kilometres.[48]Were a space activity to span 100 kilometres of elevation, the question would arise as to how to address the portion of the system that might fall below a potential demarcation line.

II. IMPLICATIONS FOR INTERNATIONAL SPACE LAW

A. FREEDOM OF ACCESS AND USE, AND NON-DISCRIMINATION

Under the Outer Space Treaty, all States have an equal right to freely access, use and explore outer space.[49] Likewise, appropriation of any portion of outer space is impermissible.[50] Thus, the exercise of sovereignty is not permitted in outer space. "By denying sovereignty in space, the major powers sought to diffuse potential conflict".[51]

Article I of the Outer Space Treaty also establishes the principle of non-discrimination in stating that space activities "shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development". Many of the States that have publicly stated a need to work toward delimitation are developing nations that wish to establish the boundary for the purpose of ensuring their right of equal access to outer space in accordance with this provision.[52] With regard to the establishment of a boundary, a limitation test relying on effective control would deprive less technologically

<http://www.worldviewexperience.com/FAA-Announcement.pdf>.

[48] Hosenball & Hofgard, *supra* note 14 at 890.

[49] *Outer Space Treaty, supra* note 1, art I.

[50] *Ibid*, art II.

[51]Jakhu, Sgobba & Dempsey, *supra* note 2 at 54.

[52] These include the Czech Republic, Bangladesh, Serbia, Thailand, Tunisia, Azerbaijan, Qatar, Belarus, Brazil, Jordan, Nicaragua, Nigeria, Ukraine, and Venezuela. See Oduntan, *supra* note 7 at 290-291.

advanced States of their rights to use and explore outer space,[53] in contravention of the Outer Space Treaty's non-discrimination clause.[54]

Should high altitude ballooning be considered a space activity, the area in which such craft would fly would thus be likely considered as outer space rather than airspace. In that case, there would be significant national security implications given the imputed freedom of use that would then apply at altitudes as low as 21 kilometres. Likewise, as this technology is considerably less expensive and better established than many other near space activities, there are more States that would be apt to undertake such initiatives, and would be entitled to the same rights of over flight under the non-discrimination principle as enjoyed by those long-established spacefaring States.

B. COOPERATION VIS-À-VIS HARMFUL INTERFERENCE

Article IX of the Outer Space Treaty establishes one of the key principles of space activities: mutual cooperation. In accordance with this provision, States are required to carry on their space activities with due regard for the activities of other States, and are required to conduct international consultations if they believe that their activities may harmfully interfere with the activities of another State. This principle should be taken into consideration in the determination of a boundary line, as this principle will be applicable above any such line and will impact the rights and responsibilities of States in carrying on relevant activities. This is particularly relevant for those activities taking place near the lower bound of near space. Increased occurrence of these activities would, by necessary extension, imply an increased likelihood of conflict with more traditional aircraft either during the launch or return process, or in case of any malfunction that could take place during their operation at full altitude. Additionally, confusion could be created as traditional aircraft may become able to reach high altitudes akin to those used by high altitude balloons. If such balloons were deemed to be operating in airspace, likewise might such aircraft. The probability of "harmful interference" would significantly increase, and the level of international cooperation required to safely maintain space activities with due regard for other States would become more burdensome.

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[53] Lachs, *supra* note 3 at 54.

[54] *Outer Space Treaty, supra* note 1, art I.

C. REGISTRATION REQUIREMENTS AND LIABILITY ISSUES

The provisions of the Outer Space Treaty establishing registration requirements and liability mechanisms, as well as the relevant subsequent treaties, will also apply to any activities occurring above the line of demarcation.[55] The Registration Convention requires registration only when "a space object is launched into earth orbit or beyond".[56] Because suborbital flights are not intended to, and never actually enter Earth orbit, they are, strictly speaking, exempt from registration requirements.[57] Likewise, high altitude balloons such as those proposed by World View Enterprises[58] would be exempt as well. If their activities are classified as space activities, this could cause a gap in the existing space law treaty regime whereby a significant proportion of space objects would be exempt from an international registration requirement. As the retention of jurisdiction and control of a space object are, by international law, directly tied to the object's entry on a national registry, this registration gap also potentially creates a significant lacuna with regard to the basis upon which a State may exercise jurisdiction and control over such objects.[59]

It has been recognised in COPUOS that the boundary question is of "paramount importance" with respect to liability for space activities in particular.[60] There is absolute liability for damage caused by a space object on the surface of the Earth or to an aircraft in flight,[61] creating a stringent regime. According to some authors, "[t]he distinction made in the Liability Convention between absolute liability for damage to the surface of the Earth or to aircraft in flight (Art. II) and fault-based liability for damage elsewhere (Art. III) implies a physical boundary".[62] Alternatively, it is possible that the Liability Convention implicates a more functionalist approach given the references to damage caused by a

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[55] *Outer Space Treaty, supra* note 1, arts VII & VIII; *Liability Convention, supra* note 21; *Registration Convention, supra* note 21.

[56] *Registration Convention, supra* note 21, art II.

[57] M Gerhard, "Space Tourism – The Authorization of Suborbital Space Transportation" in Frans G von der Dunk, ed, *National Space Legislation in Europe* (Leiden: Martinus Nijhoff Publishers, 2011) 263 at 290.

[58] "The Experience", online: World View <http://worldviewexperience.com/voyage/>.

[59] *Outer Space Treaty, supra* note 1, art 8.

[60] *Report of the Legal Subcommittee*, *supra* note 25 at 12.

[61] *Liability Convention, supra* note 21, art 2.

[62] Lyall & Larsen, *supra* note 12 at 171: see Paul Stephen Dempsey, "Liability Caused by Space Objects in International and National Law" (2011) XXXVII Ann Air & Sp L 323 at 333-69.

space object "to an aircraft in flight" and "damage being caused elsewhere than on the surface of the earth."[63]

For suborbital and other near space activities, most of such an object's journey will occur in airspace. For such activities, the likelihood that damage would be caused to an aircraft in flight or on the surface is much higher than the likelihood of damage to another space object. To foster the development of these industries, it is necessary to consider the impact that the line of demarcation will have on liability. It may be preferable to bring these activities within the well-established regime of aviation liability law,[64] though it would be necessary to consider whether such a decision would have implications with regard to the applicability of ICAO regulations, or whether it would simply subject suborbital activities to the relevant private law regime.

III. IMPLICATIONS FOR INTERNATIONAL AIR LAW

The right of innocent passage (overflight) through airspace for space objects cannot be presumed.[65] The ICJ has held that "the principle of respect for territorial sovereignty is also directly infringed by the unauthorized over flight of a State's territory by aircraft belonging to or under the control of the government of another State".[66] Likewise, the ICJ has also specifically recognised that "a boundary represents the line of separation between areas of State sovereignty, not only on the Earth's surface but also…in the subjacent column of air".[67]

According to ICAO, if suborbital vehicles were to be considered to be primarily aircraft for the purposes of international air navigation, there would be consequences under the Chicago Convention, "mainly in terms of registration, airworthiness certification, pilot licensing and operational requirements (unless they are otherwise classified as State aircraft under Article 3 of the Convention)."[68] It is conceivable that the application of licensing requirements, safety requirements, noise and emissions requirements, and other relevant regulations would comprise

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[63] *Liability Convention, supra* note 21, arts 2-3.
[64] See Paul Stephen Dempsey, *Aviation Liability Law,* 2nd ed (Markham, ON: Lexis/Nexus, 2013).
[65] ICAO Doc C-WP/8158 of 1 January 1986; Lachs, *supra* note 3 at 57.
[66] *Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v United States of America),* [1986] ICJ Rep 14 at para 251.
[67] *Frontier Dispute (Benin v Niger)* 2005 ICJ Rep 90 at para 124.
[68] Ruwantissa Abeyratne, *Air Navigation Law* (Heidelberg: Springer, 2012) at 231.

a significant burden on a fledgling industry.

Of course, another difficulty with the application of ICAO's regulations is the inapplicability to State aircraft, (such as those used in military, customs and police services) under the Chicago Convention.[69] Many States still primarily use State craft to conduct space activities, and this may create a disadvantage for States such as the United States, which have begun to utilise commercial craft for government contracts.[70]

IV. IMPLICATIONS FOR NATIONAL SPACE LAWS AND COMPLIANCE WITH INTERNATIONAL LAW

A. THE UNITED STATES

The private space sector in the US has been perceived as integral to the use of space in terms of economic viability as well as international prestige and competitiveness, to the extent that NASA has been required to utilise commercial services where possible.[71] With regard to suborbital flights, the US has labelled this form of transportation as a space activity, rather than an aviation activity.[72] As an example, the 2004 launch of SpaceShipOne "was considered a space launch and treated as such".[73] The US defines a suborbital trajectory as follows: "the intentional flight path of a launch vehicle, re-entry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth." [74] In accordance with this definition, a vehicle would be considered to an orbital vehicle if, when allowed to continue on its launch trajectory, it would not strike the surface of the Earth. It is also interesting to note that, in consideration of the demarcation issue with regard to suborbital flights:

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[69] *Chicago Convention*, *supra* note 8, art 3.

[70] For example, SpaceX has been contracted by NASA to carry cargo to the ISS since 2012. Trent J Perotto & Josh Byerly, "First Contracted SpaceX Resupply Mission Launches with NASA Cargo to Space Station" online: NASA <http://www.nasa.gov/home/hqnews/2012/oct/HQ_12-355_SpaceX_CRS-1_Launch.html>.

[71] *National Aeronautics and Space Program*, 51 USC § 20102 (2010); Paul Stephen Dempsey "The Evolution of US Space Policy" (2008) XXXIII Ann Air & So L 325 at 340.

[72] *Final Rule on Experimental Permits for Reusable Suborbital Rockets*, 72 Fed Reg 17001 (2007).

[73] Peter van Fenema, "Suborbital Flights and ICAO" (2005) 30 Air & Sp L 396 at 708.

[74] *Commercial Space Launch Activities Act*, 51 USC § 50902 (20) (2010).

> the U.S. DOT [Department of Transportation] awards commercial astronaut wings to pilots and flight crew on board a licensed launch vehicle on a flight that exceeds 80.45 kilometres as a recognition for having reached outer space.[75]

The US definition of aircraft is sufficiently broad that it could include rockets and other high altitude vehicles.[76] Based on statements by US personnel, the US believes that international air law will apply to activities that take place in near space.[77] Thus, the US seems to be drawing a distinction between national law and international law: what may be a space activity under national law can qualify as aviation under international law.

No one federal agency currently holds the full competence to regulate operations of US commercial space flights. It is also worth noting that aviation regulations do not take into consideration the possibility for suborbital point-to-point travel and thus even the US lacks a comprehensive body of law to deal with these issues.[78] It has been suggested that as suborbital markets develop, responsibility for suborbital flights "should be transitioned to other departments of the FAA, as the vehicles involved are closer to aircraft than to space objects from a legal regulatory perspective".[79]

Generally speaking, balloons must operate in compliance with Title 14 of the FAA Code of Federal Regulations.[80] In the case of high altitude balloons, in particular the model proposed by World View Enterprises, the FAA has issued a determination stating that this activity

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[75] Michael C Mineiro, "Assessing the Risks: Tort Liability and Risk Management in the Event of a Commercial Human Spaceflight Vehicle Accident" (2009) 74 J Air L & Com 371 at 373.

[76] 49 USC §40102(b) (2006) defines aircraft as "any contrivance invented, used, or designed to navigate, or fly in, the air"; Reinhardt, *supra* note 44 at 87. The situation in Canada is similar: see, Canada, *Aeronautics Act*, RSC 1985, c A-2, s 3(1).

[77] Reinhardt, *supra* note 45 at 97; *citing* Michael Sirak, "US Air Force Sees Promise in 'Near Space'" (13 October 2004), online: Jane's Defense Weekly <http://www.spacedata.net/news101304/htm> (quoting Major Elizabeth Waldrop, Chief of Space and International Law for U.S. Air Force Space Command).

[78] US Department of Transportation, *Point-to-Point Commercial Space Transportation in National Aviation System: Final Report* 7 (2010) at 8-9.

[79] Henry R Hertzfeld, *Testimony for Hearing on the Office of Commercial Space Transportation's Fiscal Year 2012 Budget Request*, House of Representatives Subcommittee on Space an Aeronautics, 5 May 2011.

[80] US, "Balloons: Regulations and Policies", online: Federal Aviation Administration <http://www.faa.gov/aircraft/air_cert/design_approvals/balloons/balloons_regs/>.

would fall under Chapter 509 of Title 51 of the United States Code, which applies to Commercial Space Launch Activities.[81] Thus, the provisions relevant to liability insurance and the payment of claims in excess of that insurance would apply.[82] While a collision with a domestic aircraft would be handled in accordance with US domestic law, it is reasonable to assume that an international collision would be handled in accordance with the absolute liability provision of the Liability Convention. This would impose a very strict standard on this burgeoning industry.

Currently, World View Enterprises proposes utilising Spaceport America[83] as its launch site, in accordance with its intention to be perceived as an operator of a space enterprise. It is worth noting, however, that the launch and landing of balloon-style craft requires significantly less surface area than the launch or landing of a craft designed for horizontal take off, and thus could potentially use alternative facilities or even airports for their operations. This would raise additional regulatory questions with regard to appropriate facilities for, and classification of, such activities.

Fundamentally, the conflict between the FAA's attempts to categorise World View Enterprises' balloons as a space activity domestically on the basis of necessary safety requirements for the craft, while explicitly ignoring the question of whether the altitudes they will operate at qualify as "space",[84] as well as other attempts to classify activities as space activities domestically but as aviation internationally, must be clarified. An agreed upon international boundary would go a long way to facilitate the resolution of these issues.

B. THE EUROPEAN UNION

The European Union's institutional framework "expressly prohibits any EU-level efforts to harmonize national regulations regarding private space activities".[85] Aviation, on the other hand, is an area of EU competence, and Member States have transferred their obligation to transpose ICAO standards through the European Aviation

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[81] *WVE FAA Announcement*, *supra* note 47.
[82] 51 USC § 50914-50915.
[83] *WVE FAA Announcement*, *supra* note 47.
[84] *Ibid*.
[85] *Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union,* 26 October 2012, OJ, C 326/01, art 189; Frans G von der Dunk, "Space Tourism, Private Spaceflight and the Law: Key Aspects" (2011) 27 Space Pol'y 146 at 149.

Safety Agency (EASA).[86] As Marciacq notes:

> Since sub-orbital aeroplanes are very similar to conventional aircraft in their design and operations besides the rocket-propelled and ballistic part of their flight, all basic requirements shall be fully applicable for the ground/air phase of the flight, at the exclusion of the rocket-powered and ballistic sub-orbital phases of the flight".[87]

To look to a Member State example, the German Federal Aviation Code also states that "spacecraft, rockets and similar flying objects" are deemed aircraft while traveling in airspace and thus must follow the relevant rules and regulations applicable to that designation.[88]

C. AUSTRALIA'S LINE OF DEMARCATION

In its national legislation, Australia has set the lower boundary for space activities for the purposes of national regulation to 100 kilometres.[89] In so doing, Australia was the first State to specify a clear line of demarcation for space activities. Australia has clarified, however, that this was not actually an attempt to create a definition or delimitation of outer space.[90] Interestingly, Australia's reforms of its National Airspace System define Class A airspace to possess an upper limit of 18.3 kilometres.[91] This would seem to create some uncertainty about the status of the area between 18.3 kilometres and 100 kilometres.

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[86] Jean-Bruno Marciacq et al, "Accommodating Sub-Orbital Flights into the EASA Regulatory System" in Joseph N Pelton & Ram S Jakhu, eds, *Space Safety Regulations and Standards* (Oxford: Elsevier, 2010) 187 at 191.

[87] *Ibid* at 196.

[88] Jakhu, *et al*, *supra* note 2 at 56; citing Comments of Germany in UNCOPUOS, *Compilation of Replies Received from Member States to the Questionnaire on Possible Legal Issues with Regard to Aerospace Objects*, UN Doc A/AC.105/635/Add.11 (26 January 2005), online: UNOOSA <http://www.unoosa.org/oosa/enSpaceLaw/aero/index.html>.

[89] Australia, *Space Activities Act 1998* (Cth), s 8, online: ComLaw <http://www.comlaw.gov.au/comlaw/Legislation/ActCompilation1.nsf/0/9ACAE6DB9C35F901C A256F7100526E2D/$file/SpaceAct98.pdf>.

[90] UNCOPUOS, *National Legislation and Practice Relating to the Definition and Delimitation of Outer Space,* UN Doc A/AC.105/865/Add.1 (20 March 2006) at 1-2 [*National Legislation and Practice*].

[91] Reinhardt, *supra* note 45 at 82, citing Stephen Angus, *NAS Implementation Group Concept 10 (Version 5.0)*, online: Australian Department of Infrastructure and Regional Development <http://www.dotars.gov.au/airspacereform/docs/nas_concept.doc>. See also National Airspace System Implementation Group (Australia), *Airspace for Everyone*, Airspace Adviser No. 1.1, at 16, 18 (2003), online: Australian Department of Infrastructure and Regional Development <http://www.dotars.gov.au/airspacereform/docs/Airspace_for_everyone.pdf>.

D. OTHER (ESPECIALLY NON-SPACE FARING) NATIONS

Despite the desire to set a demarcation line, as discussed in Section II.A., above, "non-space-faring states are in no position to exercise any pressure in the matter". [92] Regardless of this fact, many developing nations have adopted a position that there is a present need for demarcation and are actively seeking the development of a legal solution to the problem.[93] Included in these states are, for example, Azerbaijan, Bangladesh, Belarus, Brazil, the Czech Republic, Jordan, Nicaragua, Nigeria, Qatar, Serbia, Thailand, Tunisia, Ukraine and Venezuela.[94]

Domestically, some such States have set boundaries for outer space. In Belarus, for example, airspace ends and outer space begins at 20,100 meters.[95] South Africa defines outer space as "the space above the surface of the earth from a height at which it is in practice possible to operate an object in an orbit around the earth". [96] The South African example conforms more closely to a more 'standard' assessment of the line, in the 100-kilometre range. Notwithstanding the foregoing, it must be noted that if States continue the practice of unilaterally determining the location of the boundary between their respective air space and outer space, this will lead to confusion and complexity, which will be detrimental to the interests of both the aviation industry and space operations.

V. POLITICAL AND TECHNICAL CONSIDERATIONS RELATED TO THE BOUNDARY QUESTION

In April 2012, North Korea launched a rocket in a failed attempt to put a satellite into orbit. South Korea had threatened to shoot down the rocket if it entered South Korean territorial airspace. But where, exactly, was that airspace? The government of South Korea was not entirely sure. Of course, it knew its airspace extended above South Korean surface

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[92] Lyall & Larsen, *supra* note 12 at 162.

[93] Oduntan, *supra* note 7 at 290.

[94] UNCOPUOS, *Questions on the Definition and Delimitation of Outer Space: Replies from Member States,* UN Doc A/AC.105/889.

[95] *National Legislation and Practice, supra* note 90 at 3.

[96] UNCOPUOS, *Selected Examples of National Laws Governing Space Activities: South Africa*, online: UNOOSA <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/south_africa/space_affairs_act_1993E.html>.

territory, but how high up it extended had never been determined, either by South Korea itself or through any international agreement to establish a common limit.[97]

According to Judge Lachs, the "right of innocent passage should on principle be attributed to all States without discrimination".[98] Such right to traverse airspace over land or territorial waters does not currently exist in practice.[99] On the occasions that such passage has occurred without permission or objection, the absence of objection has been generally attributable to the lack of knowledge of the intrusion rather than acquiescence.[100] "Reconciliation of the right of passage with the principle of [state] sovereignty [over airspace] is not impossible, as demonstrated by the right of innocent passage through territorial waters", though no such right exists in space law.[101]

While States have the right to exclude others from their airspace and regulate said airspace accordingly, outer space is a common-pool resource (CPR). "Defining the boundaries of the CPR is an essential first step" to the effective governance of such a resource, and clearly defined boundaries have been present in other cases where CPRs have been successfully managed.[102] The issues in question with regard to regulating this CPR include not only freedom of use and rights of innocent passage, but also less obvious issues such as space traffic management, "frequency management, and consideration of stratospheric pollution",[103] including not only issues of space debris, but also such dangers as radiation, ultraviolet damage, and climate change.[104] These problems, which have also historically been faced with regard to airspace, can be adequately addressed in terms of jurisdiction without reference to sovereignty.[105]

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[97] Strauss, *supra* note 20 at 369.
[98] Lachs, *supra* note 3 at 57.
[99] Jakhu, Sgobba & Dempsey, *supra* note 2 at 55.
[100] *Ibid* at 56.
[101] Su, *supra* note 28 at 375.
[102] Weeden & Chow, *supra* note 31 at 167-168.
[103] Joseph N Pelton, *A New Integrated Global Regulatory Regime for Air and Space: Regulating the Protozone* [unpublished; on file with author] at 1.
[104] *Ibid at* 3.
[105] Lyall & Larsen, *supra* note 12 at 156-157.

There are additional benefits to States determining the upper limit of their airspace. For example, many States charge fees for aircraft flying within their airspace, meaning that there is financial value, in addition to the obvious strategic value, of determining its maximum scope in order to raise revenue from emerging activities.[106] Likewise, a State could cede airspace to another State, acquire title to a portion of another State's territorial airspace, or create rights within their airspace to assign to another State such that the relevant State could exercise attributes of sovereignty there.[107] This would create further potential financial benefit or create additional bargaining resources in negotiating bilateral or multilateral treaties and aid in the resolution of earlier raised issues.

Of course, given the potentially significant threats to national security posed by space activities to a subjacent state, particularly with regard to new near-space vehicle technologies, States are likely to extend claims of sovereignty to the maximum altitude possible.[108]

VI. SUMMARY AND CONCLUSIONS

"In pursuing the search for a solution it is essential to bear in mind the purpose it is intended to serve, i.e., to secure greater effectiveness of the law" – thus it is critical to note that the problems solved by setting a boundary are primarily legal and political, rather than scientific.[109] It cannot be expected that science will solve this problem for us; scientists will remain undecided, perhaps indifferent, and new technological or scientific developments may cause scientists to shift their perception of the boundary.[110] One key consideration, which has indeed been a roadblock in the selection of a boundary line, is the fact that once such a line is established it will be very difficult to amend.[111]

In the international arena outside space law, significant progress has been made to create boundaries in other zones of importance, which include territorial land and maritime boundaries.[112] It is important to note that the clarity provided by an established line of demarcation would promote the commercial development of space, while a failure to

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[106] Strauss, *supra* note 20 at 371.
[107] *Ibid* at 378.
[108] Su, *supra* note 28 at 92.
[109] Lachs, *supra* note 3 at 56.
[110] Oduntan, *supra* note 7 at 310.
[111] Jakhu, Sgobba & Dempsey, *supra* note 2 at 57.
[112] Oduntan, *supra* note 7 at 20.

decide resulting in ambiguity and the absence of uniformity will continue to hinder investment in and insurance of the space sector.[113] "[I]t is fairly common for nations to fail to resolve boundary issues until they become acute, rather than with preventive foresight – by which time their complexity may have increased, making diplomacy more difficult and raising the risk of military conflict."[114] Will there need to be an immediate, acute crisis before a space boundary can be set?

A 1979 proposal by the Soviet Union set out an interesting regime for delimitation of outer space. It recommended that the region above 100/110 kilometres above sea level be considered outer space and be agreed as such in a treaty, and that space objects of States:

> shall retain the right to fly over the territory of other States at altitudes lower than 100 (110) kilometres above sea level for the purpose of reaching orbit or returning to earth in the territory of the launching State.[115]

This proposal addresses both the considerations of the boundary itself and also a right of innocent passage such as would improve the ability for States to launch and re-enter their space objects without providing blanket permission for military intelligence and other such activities that may threaten national security. With regard to such a proposal, however, it would be beneficial to set the upper limit at which sovereignty could be asserted (i.e., where a right of innocent passage could be denied). Such region should include the area relevant to the use of commercial aviation, currently approximately 25-30km above sea level. Such a two-pronged proposal may be precisely what the international community needs. Ultimately, however, *caveat humana dominandi, quod omnes tangit ab omnes approbatur*; what concerns all must be approved by all.[116] Any decision at which the international community arrives would be an improvement over no decision at all.

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[113] Jakhu, Sgobba & Dempsey, *supra* note 2 at 62.

[114] Strauss, *supra* note 20 at 372.

[115] UNCOPUOS, *Draft Basic Provisions of the General Assembly Resolution on the Delineation of Air Space and Outer Space and on the Legal Status of the Geostationary Satellites' Orbital Space*, UN Doc A/AC.105/L/112 (1979).

[116] Oduntan, *supra* note 7 at 20, 312.