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Questions on suborbital flights for scientific missions and/or for human transportation

Note by the Secretariat

Addendum

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I. Introduction

1. At the fifty-fourth session of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, in 2015, the Working Group on the Definition and Delimitation of Outer Space agreed to continue to invite States Members of the United Nations and permanent observers of the Committee to provide their replies to the following questions (A/AC.105/1090, annex II, para. 17 (c)):

(a) Is there a relationship between suborbital flights for scientific missions and/or for human transportation and the definition and delimitation of outer space?

(b) Will the legal definition of suborbital flights for scientific missions and/or for human transportation be practically useful for States and other actors with regard to space activities?

(c) How could suborbital flights for scientific missions and/or for human transportation be defined?

(d) Which legislation applies or could be applied to suborbital flights for scientific missions and/or for human transportation?

(e) How will the legal definition of suborbital flights for scientific missions and/or for human transportation impact the progressive development of space law?

(f) Please propose other questions to be considered in the framework of the legal definition of suborbital flights for scientific missions and/or for human transportation.

2. The present document has been prepared by the Secretariat on the basis of a reply received from the International Association for the Advancement of Space Safety.

III. Replies received from permanent observers of the Committee on the Peaceful Uses of Outer Space

International Association for the Advancement of Space Safety

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Introduction

The lack of definition and delimitation of outer space, coupled with the dual nature of suborbital flights, constitutes an issue that has long been discussed by the Committee on the Peaceful Uses of Outer Space and is a legal hindrance to the development of suborbital spaceflights. The purpose of the present reply is to examine whether and in which way the definition and delimitation of outer space will influence the legal regime surrounding suborbital flights, and vice versa, and to present the consequent impacts on the law to be applied to suborbital flights. The reply is also aimed at broadening the scope for future research on the topic. Following the invitation from the Committee on the Peaceful Uses of Outer Space dated 26 August 2015, the present reply will be submitted to the Working Group on

the Definition and Delimitation of Outer Space by the International Association for the Advancement of Space Safety, a permanent observer of the Committee.

Question (a): Is there a relationship between suborbital flights for scientific missions and/or for human transportation and the definition and delimitation of outer space?

The term “suborbital flight” refers to vehicles that are launched for scientific and/or human transportation purposes at an altitude high enough to reach outer space (approximately 100 km above the surface of the oceans) but not with sufficient speed to achieve orbit around Earth.¹ The particular nature of such flights raises a question as to whether suborbital vehicles can be considered as spacecraft or aircraft, or a mix of the two (an aero-space craft).² Vehicles with double characteristics, such as amphibious vehicles, which can travel on land and sea, are not new. As a result, a rational question follows: “is a suborbital vehicle an aircraft that can also be operated as a spacecraft, or is it a spacecraft that can be operated as an aircraft?”. The answer to that question will have significant implications on the applicable law.³ While outer space is considered — by custom and norm — to enjoy a non-sovereign status,⁴ airspace does not. Article 1 of the Convention on International Civil Aviation states that “every State has complete and exclusive sovereignty over the airspace above its territory”. That traditional distinction can be confusing as far as suborbital flights are concerned, in the light of the lack of demarcation between airspace and outer space. It is true that “technological advancement has increased the altitude at which aircraft can sustain flight, which means the expansion of State sovereignty over the airspace of a State’s territory. Contrariwise, technological advancement has decreased the altitude at which the orbital flight of space vehicle is possible.”⁵

At the same time, suborbital operations are being planned by various entities that are expected to affect international civil aviation.⁶ The *lacunae legis* in such

¹ The vehicles do not achieve suborbital speed and are thus unable to orbit around Earth. Speed is the main element that indicates whether flights are orbital or suborbital. For instance, many space agencies routinely undertake suborbital (unmanned) launches that reach twice the altitude of the International Space Station (i.e., 700 km), without reaching orbital speed. The Chinese have also demonstrated the capability to hit a satellite (target) in geostationary orbit (i.e., 36,000 km) with a suborbital rocket. Neither of those examples can be considered as orbital flights, because of a lack of orbital speed. See Ruwantissa Abeyratne, *Space Security Law* (Heidelberg, Germany, Springer, 2011), p. 12; and National Space Society, “An introduction to the suborbital launch industry”, p. 2. Available at www.nss.org/tourism/Suborbital_presentation.pdf.

² Gbenga Oduntan, “The never ending dispute: legal theories on the spatial demarcation boundary plane between airspace and outer space”, *Hertfordshire Law Journal*, vol. 1, No. 2 (2003), pp. 64-84.

³ Frans G. von der Dunk, ed., *National Space Legislation in Europe: Issues of Authorization of Private Space Activities in the Light of Developments in European Space Cooperation*, vol. 6, *Studies in Space Law* (Leiden, the Netherlands: Martinus Nijhoff Publishers, 2011), p. 264.

⁴ See the case of the Declaration of the First Meeting of Equatorial Countries (Bogota Declaration), signed in Bogota on 3 December 1976, and the subsequent reaction of the international community; and Oduntan, “The never ending dispute”.

⁵ Gbenga Oduntan, *Sovereignty and Jurisdiction in Airspace and Outer Space: Legal Criteria for Spatial Demarcation* (New York, Routledge, 2012), p. 291.

⁶ See A/AC.105/C.2/2010/CRP.9.

demarcation, coupled with the need to enable the realization of suborbital flights, creates an undisputable relationship between the legal nature of suborbital crafts and the definition and delimitation of outer space.

Many theories have been proposed as to how airspace and outer space should be delimited.⁷ The two most popular theories — the spatialist and the functionalist approaches⁸ (which are addressed in further detail in the response to question (c) below) — prove the inevitable mutuality that exists between suborbital flights and the definition and delimitation of outer space. However, the question of the legal nature of suborbital crafts and the subsequent applicable law is not necessarily answered by either theory. By following the functionalist approach, the conclusion reached is that the craft is categorized as aircraft if its airspace nature prevails, and it is categorized as spacecraft by prioritizing its space-related purposes.⁹ Such assumptions, however, do not provide a firm definition as to the nature of the delimitation or as to the nature of the craft, and the question continues to be asked in a vicious circle.

Hence, the relationship between the issue of demarcation and suborbital flights exists in the light of the following concept: delimitating air space and outer space will not necessarily solve the problem of the nature of suborbital flights and of the law applicable to them. On the contrary, an internationally unified acceptance as to the nature of suborbital flights — given that they serve space-related purposes while mostly functioning in airspace — can influence how the issue of demarcation should be approached.

Question (b): Will the legal definition of suborbital flights for scientific missions and/or for human transportation be practically useful for States and other actors with regard to space activities?

An a priori legal definition of suborbital flights for scientific and/or for human transportation alone will not be useful for State and private space actors. Simply defining the nature of suborbital flights does not answer the question of the applicable law. Owing to the different sets of rules that govern airspace and outer space, multiple rules might apply while the craft exists in either location, even after having determined its nature. The definition of suborbital flights should be accompanied by the definition of the relevant applicable law. Should this be achieved, both State and private actors will benefit, although for different reasons.

As far as States are concerned, such an achievement will provide them with legal certainty. As derived from customary international law, States have jurisdiction and control over the activities undertaken under their supervision and, subsequently,

⁷ Oduntan, “The never ending dispute”; and Alexandra Harris and Ray Harris, “The need for air space and outer space demarcation”, *Space Policy*, vol. 22, No. 1 (2006), pp. 3-7.

⁸ Oduntan, “The never ending dispute”; and Paul S. Dempsey, *Public International Air Law* (Montreal, Canada, Institute and Centre for Research in Air and Space Law, McGill University, 2008).

⁹ See Stephan Hobe, Gerardine Meishan Goh and Julia Neumann, “Space tourism activities: emerging challenges to air and space law”, *Journal of Space Law*, vol. 33, No. 2 (2007), pp. 359-373.

they can be held responsible for them.¹⁰ By being aware of the legal regime that regulates such flights, States will be able to more effectively control the extent of their responsibility¹¹ by granting or denying authorization to such flights, since their rights and obligations will differ in each regime. Clarifying the legal regime used will have implications on the national registration of such crafts. Because dual registration is not allowed,¹² there will be no confusion as to whether registration should take place according to air law or space law rules.

Private space actors will benefit by being able to assess the risks of their investments and make cost-effective choices. There would also be a great impact on the field of space insurance. Private actors need to know the level of their potential liability in order to estimate the risks of their activities and decide to either acquire effective insurance or abstain from certain activities. Liability and insurance regimes vary depending on whether air or space law applies. Insurance would be cheaper and easier to procure for aviation activities, although regulation and safety requirements under the air law regime are much more stringent.

Thus, in theory, both types of actors will benefit should a legal regime to define and regulate suborbital flights be established: both through different kinds of legal certainty that will enable them to decide and act according to the policies they desire to follow.

Question (c): How could suborbital flights for scientific missions and/or for human transportation be defined?

There are a number of ways in which suborbital flights for scientific missions and/or for human transportation could be defined. While a spatialist approach could be used, setting a boundary above which activities would be classified as space activities, there are multiple alternatives for an applicable functionalist approach as well. Those alternatives could include the purpose of the mission, the design and licensing of the craft or the impact on air/space traffic control. While creating a simple distinction between “scientific” and “human transportation” missions would be a possibility, this would likely be an oversimplified and unhelpful approach, particularly given the ongoing development of new technologies that are likely to be used for both either simultaneously or interchangeably.

Spatialist

The spatialist approach proposes setting a measurable physical boundary below which activities will be deemed to take place in airspace and above which activities will be deemed to take place in outer space.¹³ Proposals have ranged from 20 km to

¹⁰ See *Case Concerning the Military and Paramilitary Activities in and Against Nicaragua (Nicaragua v. United States of America) Merits, Judgment, I.C.J. Reports 1986*, p. 14. Also see International Tribunal for the Prosecution of Persons Responsible for Serious Violations of International Humanitarian Law Committed in the Territory of the Former Yugoslavia since 1991, *Prosecutor v. Dusko Tadić*, case No. IT-94-1-A, 15 July 1999, para. 1546.

¹¹ Report of the Secretariat entitled “Historical summary on the consideration of the question on the definition and delimitation of outer space” (A/AC.105/769).

¹² See, for example, article 18 of the Convention on International Civil Aviation; and Ruwantissa Abeyratne, *Convention on International Civil Aviation: A Commentary* (New York, Springer, 2013), pp. vii and 253.

¹³ Dempsey, *Public International Air Law*.

1.5 million km,¹⁴ although, generally speaking, the near space area that is generally considered to be in question falls between approximately 20 km and 160 km.¹⁵ While effective control,¹⁶ aerodynamic lift and the lowest point of orbital flight¹⁷ have been considered as possibilities, it seems that the von Karman line might present a reasonable possibility for spatialist demarcation.¹⁸ Although the customary practice of States has considered anything above the lowest perigee of artificial satellites to be outer space, that only takes into account a potential lower bound of space, not an upper bound of air.¹⁹ This is particularly problematic with regard to the suborbital activities contemplated here, as they do not reach orbital velocity.²⁰ There has been a lack of political will for a hard spatialist approach, as States are concerned that such a rule might limit freedom of action.²¹

Functionalist (mission purpose)

A traditional functionalist approach maintains that the activity, rather than the location of the activity, should be the primary determinant as to whether it should be classified as an aviation or space activity.²² To give some examples, under this classification it might make sense to classify microgravity research and activities specifically for the purposes of “space tourism” as space activities, while point-to-point suborbital or hypersonic travel designed for high-speed transportation would likely be deemed an aviation activity. However, the difficulty with that approach is the assumption that objective assessments can be made regarding whether activities qualify as air or space activities.²³ It may be necessary to create very detailed rules for determining the primary purpose of an activity. For instance, Swiss Space Systems (S3), a Swiss company, foresees the possibility of launching nanosatellites from its suborbital, unmanned Airbus A300 aircraft (a Zero-G-certified Airbus A300) from an altitude of 80 km to 700 km, and plans on testing such missions in 2017.²⁴ That objective raises a question as to the point after which such operations should be considered as space activities.

¹⁴ Oduntan, *Sovereignty and Jurisdiction in Airspace and Outer Space*.

¹⁵ Michael J. Strauss, “Boundaries in the Sky and a Theory of Three-Dimensional States”, *Journal of Borderland Studies*, vol. 28, No. 3 (2013), pp. 369-382 (Strauss’s article discusses a range of 20 km to 100 km, but that range has been expanded here to include the range pertaining to the practice of States).

¹⁶ *Case Concerning the Military and Paramilitary Activities in and Against Nicaragua*, para. 115; and Oduntan, *Sovereignty and Jurisdiction in Airspace and Outer Space*.

¹⁷ Oduntan, *Sovereignty and Jurisdiction in Airspace and Outer Space*.

¹⁸ National Aeronautics and Space Administration, “Schneider walks the walk”, 21 October 2005. Available at www.nasa.gov/centers/dryden/news/X-Press/stories/2005/102105_Schneider.html.

¹⁹ Jinyuan Su, “The delimitation between airspace and outer space and the emergence of aerospace objects”, *Journal of Air Law and Commerce*, vol. 78 (2013).

²⁰ Tanja Masson-Zwaan and Steven Freeland, “Between heaven and Earth: the legal challenges of human space travel”, *Acta Astronautica*, vol. 66, Nos. 11 and 12 (2010), pp. 1597-1607.

²¹ Brian C. Weeden and Tiffany Chow, “Taking a common-pool resources approach to space sustainability: a framework and potential policies”, *Space Policy*, vol. 28, No. 3 (2012), pp. 166-172.

²² Dempsey, *Public International Air Law*.

²³ S. Neil Hosenball and Jefferson S. Hofgard, “Delimitation of air space and outer space: is a boundary needed now?”, *University of Colorado Law Review*, vol. 57, No. 5 (1986).

²⁴ Swiss Space Systems, “Missions and goals”. Available at www.s-3.ch/en/mission-goals.

Functionalist (design and licensing)

Based on recent technological and national developments, a form of functionalist approach that would be based upon the classification of the vessel itself has emerged as a possibility. For example, World View Enterprises is planning to undertake commercial “space flights”, utilizing a balloon that only ascends to approximately 30 km.²⁵ For the purposes of safety and regulation of their human-rated module, the Federal Aviation Administration (FAA) of the United States of America is regulating this vehicle as a spacecraft because of its design specifications, despite its low maximum altitude.²⁶ One more relevant example is the New Sheppard craft, designed by the Blue Origin Company. The company aims to launch a two-stage rocket and capsule orbital launch system, which will function at two stages: after the booster separates from the capsule (at an altitude of approximately 93 km), it will return to Earth and the capsule will be propelled into low-Earth orbit (180-2,000 km altitude).²⁷ After the completion of its (scientific or exploration) mission, the capsule will re-enter the Earth’s atmosphere and will land assisted by parachutes.²⁸ According to FAA, whatever operates above the controlled airspace (18.3 km, or “FL600” in aviation language) is considered spacecraft, although the Administration underlines in its documents that that does not signify recognition of the limit of airspace being at 18.3 km.²⁹

Functionalist (impact on air/space traffic control)

Another alternative within the functionalist classification is to determine whether the activity would be managed primarily within air traffic or space traffic. That approach seems sensible from the perspective of practical considerations of registration requirements, determinations of liability and protection of national sovereignty. However, the consequences of that approach from a regulatory perspective would place emerging new space suborbital activities under the stringent Convention on International Civil Aviation regime,³⁰ especially by taking into account the altitude that such flights can achieve; although suborbital projects are currently limited to approximately 100 km, suborbital flights reaching 150 km are possible.³¹ In such a case, space collision avoidance regulations may be deemed applicable, given the 120 km physical limit between airspace and outer space.³²

²⁵ Brian Dodson, “World view enterprises near-space balloon flights to begin in 2016”, 24 October 2013. Available at www.gizmag.com/space-tourism-balloon-world-view/29510/.

²⁶ Mark W. Bury, Assistant Chief Counsel for International Law, Legislation and Regulations Division, Federal Aviation Administration, “Interpretation of the Federal Aviation Administration’s aviation and space statutes”, letter dated 26 September 2013. Available at www.worldviewexperience.com/FAA-Announcement.pdf.

²⁷ Holli Riebek, “Catalog of Earth satellite orbits”, 4 September 2009. Available at <http://earthobservatory.nasa.gov/Features/OrbitsCatalog/>.

²⁸ See www.blueorigin.com/technology.

²⁹ Dodson, “*World view enterprises*”.

³⁰ Ruwantissa Abeyratne, *Air Navigation Law* (Heidelberg, Germany, Springer, 2012), p. 231.

³¹ A/AC.105/1039/Add.2.

³² Thomas W. Schlatter, “Atmospheric Composition and Vertical Structure” in *Encyclopedia of Aerospace Engineering*, Richard Blockley and Wei Shyy, eds., vol. 6, *Environmental Impact and Manufacturing and Operations*, part 27 (Reston, Virginia, United States of America, American Institute of Aeronautics and Astronautics, 2010).

Question (d): Which legislation applies or could be applied to suborbital flights for scientific missions and/or for human transportation?

The applicable legislation depends on the potential delimitation of outer space and classification of flights. In addition, applicable legislation (widely defined) can include both international law and national law. If suborbital flights are classified as spaceflights in terms of space law, the following legislation would apply under international law, for States who are parties to the relevant treaties: the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies; the 1968 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space; the 1972 Convention on International Liability for Damage Caused by Space Objects; the 1976 Convention on Registration of Objects Launched into Outer Space; and the 1984 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies. Customary international law would also apply to all States, regardless of whether or not they are party to the space treaties.³³ For example, the non-appropriation principle contained in article II of the Outer Space Treaty is representative of customary international law.³⁴ National laws and regulations of space activities would also apply to activities within their respective jurisdictions, in particular, national definitions of air flight and space flight, safety regulation, licensing procedures and insurance requirements. Australia and the United States are examples of two countries with detailed legislation.³⁵

If suborbital flights are classified under the purview of air law, both the Convention on International Civil Aviation and the applicable private international air law regime under the Convention for the Unification of Certain Rules Relating to International Carriage by Air signed at Warsaw on 12 October 1929 or the Convention for the Unification of Certain Rules for International Carriage by Air done at Montreal on 28 May 1999 (depending on which convention(s) an individual State has ratified) would apply. Additionally, national laws and regulations on air

³³ Bin Cheng, "Custom: the future of general State practice in a divided world" in *The Structure and Process of International Law: Essays in Legal Philosophy Doctrine and Theory*, R. St. J. Macdonald and Douglas M. Johnston, eds. (Dordrecht, the Netherlands, Martinus Nijhoff Publishers, 1986).

³⁴ Eilene Galloway, "Maintaining international space cooperation for peaceful uses", *Journal of Space Law*, vol. 30, No. 2 (2004); Bin Cheng, *Studies in International Space Law* (Oxford, Clarendon Press, 1997); Steven Freeland and Ram Jakhu, "Article II of the Outer Space Treaty" in *Cologne Commentary on Space Law* vol. I, *Outer Space Treaty*, Stephan Hobe, Bernhard Schmidt-Tedd and Kai-Uwe Schroggl, eds. (Cologne, Carl Heymanns Verlag, 2010); Virgil Pop, *Who Owns the Moon?: Extraterrestrial Aspects of Land and Mineral Resources Ownership*, Space Regulations Library Series, vol. 4 (New York, Springer, 2008); Ricky J. Lee and Felicity K. Eylward, "Article II of the Outer Space Treaty and human presence on celestial bodies: prohibition of state sovereignty, exclusive property rights, or both?" in *Proceedings of the Forty-eighth Colloquium on the Law of Outer Space* (Reston, Virginia, American Institute of Aeronautics and Astronautics, 2006); Francis Lyall and Paul B. Larsen, *Space Law: A Treatise* (Burlington, United States, Ashgate Publishing Company, 2009), e-book; and Kenneth F. Schwetje, "Protecting space assets: a legal analysis of keep-out zones", *Journal of Space Law*, vol. 15, No. 2 (1987), pp. 131-146.

³⁵ See, for example, Australia, *Space Activities Act 1998*, No. 123, 1998 as amended (Canberra, 2013); and United States, Office of the Law Revision Counsel, Commercial Space Launch Activities Act of 1998, *United States Code*, Title 51, subtitle V, chap. 509, sects. 50901-50923 (2010).

flight, in particular, national definitions of air flight and space flight and regulation of licensing, safety and insurance would apply.

Question (e): How will the legal definition of suborbital flights for scientific missions and/or for human transportation impact the progressive development of space law?

A legal definition of suborbital flights would have the following impacts on the progressive development of space law:

(a) A legal decision specifically relating only to suborbital flights would be likely to create a push for a decision on delimitation of outer space or a more comprehensive classification of other activities, as the issue of suborbital flights is part of the general issue of delimitation;

(b) Such a definition would encourage individual States to promulgate appropriate legislation and/or administrative regulations appropriate to their activities;

(c) Classification of suborbital flights as air flights under the air law regime will impact the progressive development of space law primarily by removing from its scope all such activities, and probably all other activities taking place at a lower altitude than the classified suborbital flights. It would keep space law more focused and therefore easier to develop in a streamlined fashion. It would have the reverse impact on air law, however, as it would need to be more adaptable to accommodate the new technologies, with licensing, safety and liability regimes that would allow these activities to develop in a sustainable fashion;

(d) Classification of suborbital flights as space flights under the regime of space law would have several additional impacts on the progressive development of space law, mainly by:

(i) Encouraging clarification of the status of the space itself in which those flights take place, even if no push to set a specific line of demarcation is made, in order to ascertain whether it is under State sovereignty or it is access-free outer space. In that context, and if the second option is chosen, it will require answering the national security concerns of States, as the altitude of some types of suborbital flights can be relatively low;

(ii) Implying the need for revisiting the question of a possible right of innocent passage (over flight) for space activities in what otherwise might be considered air space;

(iii) Bringing a need for regulation on safety and traffic control to prevent collisions with aircraft and other suborbital craft as they become more common. Such regulations are already present in the air law regime but not under space law. Moreover, regulation on traffic management will need to be made in correlation to the traffic control regime for air flight and implemented in cooperation with air flight control and management, as suborbital flights spend a substantial portion of their mission time in air space;

(iv) Increasing the likelihood of implementation of bilateral agreements governing suborbital flights and other space activities between States;

(v) Elevating the importance of rules on environmental protection relevant to those flights, which are being made in relatively low altitudes and could have a notable environmental impact, particularly depending on the fuel used and the frequency of flights;

(vi) Solidifying the principles of non-discrimination and the duty of international cooperation with regard to those flights.

Radio frequency allocation is already addressed by the International Telecommunication Union with regard to both air and space activities, so the issue should not have additional impact in that area.

Question (f): Please propose other questions to be considered in the framework of the legal definition of suborbital flights for scientific missions and/or for human transportation

(a) How can a regime for the definition and delimitation of outer space adapt to, or be sufficiently flexible to accommodate, consistently changing technological realities?

(b) What impact would the adoption of a rule for the definition and delimitation of outer space have on national security concerns?

(c) How will a rule of definition and delimitation of outer space affect existing and targeted levels of aerospace safety?

(i) How will a rule of definition and delimitation of outer space affect existing air traffic control mechanisms?

(ii) How will a rule of definition and delimitation of outer space contribute positively to or detract from the development of a space traffic control regime?

(d) How can varying national legal regimes be harmonized at this stage to ensure regulatory certainty?

(e) Will any new regime have an impact on the equitable and rational use of the increasingly congested low-Earth orbits?

(f) Could the (legal) definition of a transition region (e.g., from 20 km to 160 km) instead of a demarcation line be a better solution? Special (security) rights in such a region could be granted to the underneath State.