



Universiteit
Leiden
The Netherlands

Widening the horizons of outer space law

Masson-Zwaan, T.L.

Citation

Masson-Zwaan, T. L. (2023, February 9). *Widening the horizons of outer space law*. *Meijers-reeks*. Retrieved from <https://hdl.handle.net/1887/3562089>

Version: Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/3562089>

Note: To cite this publication please use the final published version (if applicable).

IX Human Spaceflight*

1 INTRODUCTION

This chapter will address two kinds of human presence in outer space. First, it will discuss orbital spaceflight, focusing mainly on the International Space Station (ISS). The ISS has hosted professional astronauts since 2000, and several paying passengers between 2001 and 2009. Before the ISS, there have been a few other stations where astronauts have lived and worked, but the ISS is the first international venture and presents the most interesting legal questions. Secondly, sub-orbital flights will be addressed, and some of the many unresolved legal questions this raises will be highlighted. Contrary to orbital flights, sub-orbital flights with paying passengers have not yet happened. This activity has promising prospects that go beyond bringing wealthy individuals to the edge of space, as it may be the first step towards point-to-point transportation via outer space.

2 ORBITAL HUMAN SPACEFLIGHT

2.1 The International Space Station

Several 'space stations' have orbited the Earth since the 1970s, but at the time of writing only the International Space Station (ISS) and the Chinese Tiangong 2 are still operational.¹ The ISS is a prime example of successful international cooperation in the exploration and use of outer space for

* *Introduction to Space Law*, T. Masson-Zwaan and M. Hofmann (Kluwer, 2019), pp. 79-95.

1 Predecessors to ISS were Skylab (1973–1979), Salyut 7 (1982–1991), Mir (1986–2001), and Tiangong 1 (2011–2018). Tiangong 2 was launched in 2016 and is likely to be de-orbited in 2019, according to a report in Space News, 27 Sept. 2018, *see* <https://spacenews.com/china-could-be-facing-space-station-delay-tiangong-2-to-be-deorbited/>. Plans for a new, permanently crewed version of Tiangong were announced in Nov. 2018, *see* http://www.spacedaily.com/reports/China_unveils_new_Heavenly_Palace_space_station_as_ISS_days_numbered_999.html (all websites cited in this chapter were last accessed and verified on 6 Nov. 2018). The Russian Mir was the first 'modular' station. i.e. assembled in space, like the ISS.

peaceful purposes.² The plan for a space station was initiated by President Reagan of the United States in 1984 and a first Intergovernmental Agreement was concluded in 1988, but not until Russia joined the partnership in 1998 did construction really begin. The ISS has been permanently inhabited since October 2000.³ In 2009, the number of crew on board increased from three to six, and two Soyuz capsules are now constantly docked to the station to bring the crew home in case of an emergency. Operation of the ISS is currently foreseen until 2024.

The ISS is a civil station for peaceful purposes built and operated by five Partners: the USA, eleven Member States of the European Space Agency (ESA) forming the European Partner,⁴ Russia, Japan and Canada, and their space agencies (NASA, ESA, the Russian agency Roscosmos, the Japanese Aerospace Exploration Agency JAXA and the Canadian Space Agency CSA). It is as large as a football field and can be seen in the sky when it passes over at an altitude of approximately 400 km.⁵ The ISS serves many different peaceful purposes, such as scientific research, development of applications in space, demonstration of new technologies, education, commercial activities, as a platform for space exploration missions, and even as a deployment facility to place small satellites into orbit.

Since the US Space Shuttle was retired in 2011, the Russian Soyuz has been the only launch vehicle capable of transporting humans to and from the station.

The legal framework governing the ISS is unique. The fifteen States signed a multilateral treaty named the ISS 'Intergovernmental Agreement' (IGA) on 28 January 1998.⁶ A second layer of agreements consists of Memoranda of Understanding (MOU), between NASA and the four other space agencies. At the third level, there are bilateral implementation agreements. A few features of the IGA are highlighted below.

-
- 2 For general information about the ISS, see e.g. the webpages of ESA and NASA dedicated to the ISS at <http://www.esa.int/esaHS/iss.html> and http://www.nasa.gov/mission_pages/station/main/index.html. For the legal aspects of ISS, see F. Lyall & P. Larsen, *Space Law: A Treatise* 110–114 (2nd ed., Routledge 2018), C. Sharpe & F. Tronchetti, *Legal aspects of public manned spaceflight and space station operations*, in F. von der Dunk & F. Tronchetti (eds.), *Handbook of Space Law* 618–661 (Elgar 2015) and F.G. von der Dunk & M. Brus (eds.), *The International Space Station: commercial utilization from a European Legal Perspective* (Brill 2006).
 - 3 The previous record was held by Mir (10 years minus 8 days).
 - 4 They are Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland, and the UK (the latter contributes since 2011). For ESA, this is a so-called 'optional programme' to which not all Member States have to contribute, only if they choose to.
 - 5 See <https://spotthestation.nasa.gov/sightings/> to find upcoming space sighting opportunities for any location.
 - 6 The ISS IGA can be accessed via <https://www.state.gov/documents/organization/107683.pdf>. See also https://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/International_Space_Station_legal_framework.

2.2 Compliance with International Law

First, it is not the aim of this agreement to replace the international legal framework put in place under the auspices of the United Nations,⁷ nor to replace other instruments and rules of public international law. Instead, Article 2 of the IGA provides that the ISS is to be operated in accordance with international law. In several instances, reference is made to specific provisions of the UN space treaties, and all Partners are a party to at least four of those treaties.⁸

2.3 Registration

Article II of the Registration Convention requires the launching State to enter a space object it launches into ‘an appropriate registry’, and when there are two or more launching States, they shall jointly determine who will register the object, and may conclude agreements about jurisdiction and control over the object and any personnel thereof (paragraph 2). To comply with this treaty obligation, Article 5 of the IGA settles the question of registration of the flight elements of the Space Station as follows.

Each Partner shall register as space objects the flight elements it provides. This implies that each flight element is a ‘space object’ and each Partner retains jurisdiction and control over its flight elements. This is in accordance with Article VIII of the Outer Space Treaty and Article II of the Registration Convention. The European Partner has delegated the responsibility to register to its Cooperating Agency, ESA, acting in its name and on its behalf. ESA is entitled to do so pursuant to its Declaration of Acceptance of the Registration Convention. As such, the ISS is a ‘patchwork’ of different jurisdictions.

7 This framework consists of the following treaties: (i) Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, adopted on 19 Dec. 1966, entered into force on 10 Oct. 1967, 610 UNTS 205 (hereafter also referred to as OST or Outer Space Treaty), *see* Annex 1; (ii) Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, adopted on 19 Dec. 1967, entered into force on 3 Dec. 1968, 672 UNTS 119 (hereafter also referred to as ARRA or Rescue Agreement), *see* Annex 2; (iii) Convention on International Liability for Damage Caused by Space Objects, adopted on 29 Nov. 1971, entered into force on 1 Sept. 1972, 961 UNTS 187 (hereafter also referred to as LIAB or Liability Convention), *see* Annex 3; (iv) Convention on Registration of Objects Launched into Outer Space, adopted on 12 Nov. 1974, entered into force on 15 Sept. 1976, 1023 UNTS 15 (hereafter also referred to as REG or Registration Convention), *see* Annex 4; and (v) Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, adopted on 5 Dec. 1979, entered into force on 11 July 1984, 1363 UNTS 3 (hereafter also referred to as MOON or Moon Agreement), *see* Annex 5. *See also* the extensive analysis of these treaties in Ch. 2.

8 As of 1 Jan. 2018, the USA, Russia, Japan and Canada were parties to all treaties except MOON. The same applies to the eleven Members who participate in the ISS, except that the Netherlands and Belgium also ratified MOON. ESA has made declarations of acceptance to REG, LIAB and ARRA.

2.4 Liability Waivers

An innovative feature is Article 16 of the IGA, addressing liability. Of course, the liability provisions of the UN space treaties also apply, as far as damage caused by or to the ISS by non-partners is concerned. Specifically, fault liability would apply for damage caused in outer space as per Article III of the Liability Convention. However, this does not pertain to damage that might be caused by one ISS Partner to another. In order not to endanger the ISS cooperation by a situation where Partners would bring multiple claims against each other, the IGA contains a so-called 'cross-waiver' of liability among the Partners through Article 16. This means that each Partner agrees not to hold the others liable in case of damage.

The waiver does not apply in case of wilful misconduct, personal injury or claims related to intellectual property, and it must be flowed down to the entire chain of contractors and subcontractors. So far there have been no claims for damage caused to or by the ISS by or to external parties, nor among the Partners.

2.5 Intellectual Property Rights

Intellectual property rights are the subject of Article 21 of the IGA, which provides that an activity occurring in or on a flight element is deemed to have occurred in the territory of the Partner State of that element's registry. For instance, a patent for an invention made on the Japanese laboratory module may be filed anywhere in the world, but Japan will be considered as the State where the invention originally took place. For the European Partner this again presents a complication, and it was decided that any European Partner State may extend its national law to the European elements and consider the activity to have occurred within its territory. In theory, an invention occurring in the European Columbus laboratory module could thus be deemed to have occurred in any of the eleven European States participating in the ISS program, insofar as it has made its national law applicable to the Columbus module.

2.6 Criminal Jurisdiction

Criminal jurisdiction is elaborated in Article 22 of the IGA. It states that in principle the State of nationality of the alleged perpetrator of a criminal act has jurisdiction to prosecute, but if it fails to do so within a reasonable period, the State of nationality of the victim has the right to do so. The IGA may serve as extradition agreement.⁹ This provision has not yet been put to the test.

⁹ This is often done to facilitate extradition, as most States refuse to extradite their nationals unless an extradition treaty exists.

2.7 Use of the ISS

Looking at users' rights and the possibility of allowing commercial use of the ISS, neither the IGA nor the MOU's contain explicit references to commercial utilisation, but they do provide that each Partner may use equipment and facilities in or on each other Partner's elements in accordance with their respective 'utilisation rights' as per Article 9 IGA. Partners may barter or sell any portion of its allocation to other partners – or even non-partners if the others agree.¹⁰

2.8 Crew

Each Partner is allowed to assign astronauts to serve as crew on board the ISS. Under Article V of the Outer Space Treaty, astronauts are called 'envoys of mankind', and they enjoy the right to assistance in case of accident, distress or emergency landing under the provisions of the Rescue Agreement. However, those rules do not establish any 'chain of command' on board a space station, and therefore Article 11 of the IGA provides that a Crew Code of Conduct should be established for that purpose. This Code was adopted in 2000 and establishes such a chain of command and specifies the rules, standards and responsibilities that crew must abide by from the moment they are assigned to a certain mission until the end of post-flight requirements. For example, crew members may carry mementos, such as flags or patches, i.e., small items of minor value, but these may not be sold, transferred for sale, used or transferred for personal gain or used or transferred for any commercial or fundraising purpose. Personal effects like a wristwatch are not considered mementos.

In 2001, the Multilateral Crew Operations Panel (MCOP) adopted the 'Principles Regarding Processes and Criteria for Selection, Assignment, Training and Certification of ISS (Expedition and Visiting) Crewmembers', which introduced the category of 'spaceflight participants', as opposed to professional astronauts and cosmonauts, in order to provide for visitors

10 See R. Veldhuyzen & T. Masson-Zwaan, *ESA Policy and Impending Legal Framework for Commercial Utilisation of the European Columbus Laboratory Module of the ISS* in F. von der Dunk & M. Brus (eds.), *supra* n. 2 at 47–62.

wishing to experience a stay in an orbital space station.¹¹ Seven wealthy individuals have thus visited the ISS between 2001 and 2009, as the Russian Partner sold spare seats on the Soyuz transportation vehicle for a price ranging between twenty and forty million US dollars, via the company Space Adventures.¹² When the ISS crew doubled from three to six in 2009, this was no longer possible.

The Commander of the Station is responsible for ensuring the crew's safety and health, maintains order and implements disciplinary regulations, enforces procedures for security operations and protects equipment and payloads on board the Station. It is however the flight director on the ground who has overall responsibility for the mission, operations and decisions.

2.9 The Future

As stated above, for the time being it is the intention of the Partners to operate the ISS until 2024. It could probably even be kept operational for a longer time, and one option is to gradually transfer some of the responsibilities to the private industry, although crew health and safety are likely to remain under government control.¹³ But commercial entities are already involved in other ways. The US company Nanoracks has been deploying cubesats from the ISS since many years. Another example of involvement of the private industry is the Bigelow Expandable Activity Module (BEAM)

11 Spaceflight participants are defined as 'individuals (e.g. commercial, scientific and other programs, crewmembers of non-partner space agencies, engineers, scientists, teachers, journalists, filmmakers or tourists), sponsored by one or more partner(s); normally this is a temporary assignment that is covered under a short-term contract.' They are eligible for assignments as visiting scientist, commercial user or tourist, but their task assignment cannot include ISS assembly, operations and maintenance activities. On the other hand, a professional astronaut/cosmonaut is defined as 'an individual who has completed the official selection and has been qualified as such at the space agency of one of the ISS partners and is employed on the staff of the crew office of that agency'. Only professional astronauts/cosmonauts are eligible for assignment as crew commander, pilot, flight engineer, station scientist or mission specialist. The Principles are available at https://www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/ISS_partners_release_crew_criteria_document.

12 See <http://www.spaceadventures.com>. Initially, the company MirCorp, incorporated in the Netherlands, was planning to facilitate private space travel to Mir, and had actually already signed a contract with Dennis Tito who later became the first paying passenger to ISS. But eventually Russia decided to deorbit Mir and partner with the USA and others instead, in order to build the ISS. See about MirCorp, <http://mircorp.org/index.html>. It is still uncertain whether private trips to ISS will happen again in the future, but Space Adventures still proposes the 'ISS experience' on its website.

13 D. Werner, *Trump wants NASA out of the ISS operations business. Easier said than done*, Space News, 5 July 2018. <http://spacenews.com/trump-wants-nasa-out-of-the-iss-operations-business-easier-said-than-done/>.

that docked with the Station in 2016.¹⁴ Supply missions to the ISS are carried out by SpaceX and Boeing under contract with NASA, of course with the approval of the other Partners. In the future they will also handle crew transportation, but the certification of commercial vehicles capable of carrying crew to the Station is likely to be delayed. This may increase the dependency on the Russian partner beyond the agreed timeline, and may affect access to the ISS.¹⁵

Before the Station spins out of control at the end of its useful life, a decision on de-orbiting it during a controlled re-entry will have to be taken by the Partners; this will be a very complex operation requiring careful preparation.¹⁶

At the same time, work has already started on a follow-up programme, named 'the Gateway', to be placed in the vicinity of the moon as a kind of outpost, to provide shelter, relay communications, and stock supplies for astronauts traveling to more distant destinations and also serving as a research facility.¹⁷ It is meant as a (much smaller) follow-up to ISS, involving the same international partners, but also private industry. One of the questions that arises in terms of legal and policy aspects of such a multinational cooperative venture is whether the ISS model can serve as an example for future endeavours, such as a mission to the Moon or Mars. It is clear that the experience gained with the ISS is of huge importance for any future major international cooperation in the use and exploration of space, despite the financial, technological and legal hurdles it had to overcome.¹⁸ The ISS has demonstrated that States can work together in space despite political tensions on Earth, and the benefits, expertise and knowledge generated by the ISS for humankind are immense.¹⁹

14 See https://www.nasa.gov/mission_pages/station/research/experiments/1804.html.

15 The US GAO (Government Accountability Office) has estimated that 'Boeing and SpaceX could miss their current schedules for having their commercial crew vehicles certified by NASA by a year or more, creating a gap in access to the station when the agency's use of Soyuz seats ends late next year', see J. Foust, *Commercial crew delays threaten access to ISS*, GAO warns, Space News, 11 July 2018, <https://spacenews.com/commercial-crew-delays-threaten-access-to-iss-gao-warns/>.

16 See also Ch. 8 on space debris.

17 See e.g. https://www.esa.int/Our_Activities/Human_Spaceflight/Exploration/Space_gateway or <https://www.nasa.gov/feature/nasa-s-lunar-outpost-will-extend-human-presence-in-deep-space>.

18 The IISL dedicated several sessions to the topic of space station, such as in 1999 in Amsterdam, *Legal aspects of space station utilization* (AIAA 2000), in 2002 in Houston, *ISS and the Law* (AIAA 2003), and in 2014 in Toronto, *The ISS IGA: Lessons Learned and Looking to the Future* (Eleven 2015).

19 It has been proposed to nominate the ISS for the Nobel Prize, see W. Peeters, *ISS as a Nobel Peace Prize Nominee? Why Not?* Space News, 17 Feb. 2014, <http://spacenews.com/39540iss-as-a-nobel-peace-prize-nominee-why-not/>.

3 SUB-ORBITAL FLIGHTS

3.1 Introduction

Ever since the Ansari X-prize in 2004²⁰, several companies have been preparing the technology for commercial sub-orbital flights for private individuals.²¹ Sub-orbital flight in itself is not a new activity. For instance, sounding rockets are used to conduct experiments in microgravity and ballistic missiles carry warheads. But what is new is using this technology to send paying individuals into outer space – or is it airspace? Are these vehicles rockets or planes, and are the persons they will carry ‘astronauts’ or just passengers on board an aircraft? What laws should apply? Much has been written about the legal aspects of sub-orbital flights for private individuals,²² but no concrete answers are available.

UNCOPUOS has been debating the topic of definition and delimitation of outer space since several decades, but has not come up with a solution – partly because some States prefer to leave the question open for political reasons.²³ So the question remains open at the level of international law, while some States have started to provide for a boundary in their national law. With the advent of sub-orbital flights, this question becomes of more practical relevance than ever before. States need to know how to address and regulate this new activity, and struggle with issues like safety, licensing

20 See <http://ansari.xprize.org>. The prize aimed ‘to challenge teams from around the world to build a reliable, reusable, privately financed, manned spaceship capable of carrying three people to 100 kilometers above the Earth’s surface twice within two weeks’.

21 During a sub-orbital flight, orbital velocity is not achieved. Vehicles usually attain an altitude of around 100 km, then shut down their engine resulting in three to minutes of microgravity, after which the vehicle re-enters the atmosphere and returns back to Earth.

22 See e.g. T. Masson-Zwaan & R. Moro-Aguilar, *Regulating private human sub-orbital flight at the international and European level: tendencies and suggestions*, 92 *Acta Astronautica* 243–254 (2013); T. Masson-Zwaan & S. Freeland, *Between heaven and earth: The legal challenges of human space travel*, 66 *Acta Astronautica* 1597–1607 (2010); T. Masson-Zwaan, *Regulation of Sub-orbital Space Tourism in Europe: A Role for EU/EASA?*, 35 *Air and Space Law* 263–272 (2010); R. Moro-Aguilar, *National Regulation of Private Suborbital Flights: A Fresh View*, 10 *FIU L. Rev.* 679–711 (2015); Lyall & Larsen, *supra* n. 2 at 227–234, F. von der Dunk, *Legal aspects of private manned spaceflight*, in F. von der Dunk & F. Tronchetti, *Handbook of Space Law*, *supra* n. 2 at 662–716, S. Hobe, G. Goh & J. Neumann, *Space Tourism Activities – Emerging Challenges to Air and Space Law?*, 33 *JSpaceL* 359–373 (2007); F. von der Dunk, *Passing the Buck to Rogers: International Liability Issues in Private Spaceflight*, 86 *Nebraska Law Review* 400–438 (2007), S. Hobe, *Legal Aspects of Space Tourism*, *ibid.* at 439; and S. Freeland, *Up, up and Back: The Emergence of Space Tourism and its Impact on the International Law of Outer Space*, 6 *Chicago J Int. L.* 1–22 (2005). The IISL dedicated several sessions to the topic of sub-orbital flights, e.g. in 2007 in Hyderabad, *Legal issues of private spaceflight and space tourism* (AIAA 2008), in 2011 in Cape Town, *Legal issues of commercial human spaceflight*, (Eleven 2012) and in 2014 in Toronto, *Legal issues associated with private human flight, including space and ground facilities, traffic management and spaceports* (Eleven 2015).

23 On the discussions in UNCOPUOS on the definition and delimitation of outer space, see Ch. 1, §1.05, and relevant documents at <http://www.unoosa.org/oosa/en/ourwork/copuos/lsc/ddos/index.html>.

or certification requirements. At the same time, industry is concerned about the lack of clarity regarding for instance liability exposure, insurance implications and passengers' rights. The two leading companies in this field are Virgin Galactic and Blue Origin.²⁴

The concept of Virgin Galactic involves a launch of six passengers and two pilots on board 'SpaceShipTwo', which separates at 15.000 meters from the mothership 'WhiteKnightTwo'. The total flight duration is around two hours, during which passengers will float for several minutes in zero-gravity before 'gliding' back to Earth to its home base, Spaceport America in New Mexico.²⁵ In the future, flights will also be planned from elsewhere.²⁶ The tickets cost 250,000 US dollars, and more than six hundred passengers have reportedly already signed up and made initial payments.

Blue Origin's concept is different, its 'New Shepard' resembles a capsule which is fixed on top of a rocket. The ten-minute flight will transport six passengers, and returns to Earth by means of parachutes and retrorockets. Tickets are not yet on sale and prices have not been announced yet, but the company expects to start doing so in 2019.²⁷

Looking at the applicable law, if flights do not cross borders, i.e. if they take off and land in one State, national law would apply. Insofar as sub-orbital flights would have trans-boundary effect, i.e., take off and land in different States, national law may still apply if there is no applicable international law or bilateral agreement. The current options would be to apply either international air law or international space law to such international flights. However, their characterisation as either aviation or space activity remains unclear, and both regimes have some positive and negative aspects. For instance, space law is incomplete in terms of rules on carrier liability, crew and passengers, whereas air law is so comprehensive that it may hinder the new industry. In the next paragraphs, these scenarios will be analysed further.

3.2 National Law

Many of the currently planned sub-orbital flight companies plan to operate from one territory only, at least initially, and this will most likely be the USA. As long as the vehicles 'take off' and 'land' in the same State, that State's

24 See <http://www.virgingalactic.com/> and <https://www.blueorigin.com/new-shepard>. Several others had advanced plans but ended their activities, most notably XCOR Aerospace, which filed for bankruptcy in 2017, see <http://spacenews.com/xcor-aerospace-files-for-bankruptcy/>.

25 See <http://www.spaceportamerica.com>.

26 A second spaceport may be opened at an airport in the south of Italy, see I. Couronne, *First space tourist flights could come in 2019*, Space Daily, 13 July 2018, http://www.spacedaily.com/reports/First_space_tourist_flights_could_come_in_2019_999.html.

27 J. Foust, *Blue Origin plans to start selling sub-orbital spaceflight tickets next year*, Space News, 21 June 2018, <https://spacenews.com/blue-origin-plans-to-start-selling-sub-orbital-spaceflight-tickets-next-year/>.

national law will apply. In addition, as long as there is no international regime that has been agreed to apply to sub-orbital activities, each State has the right to regulate human sub-orbital flights launching from and operated within its territory according to its own preferences, and hence it is free to decide whether these flights are to be considered as aviation or rocket launches,²⁸ possibly adapting existing regulatory frameworks to the specific needs of sub-orbital flights.

3.2.1 USA

The United States was the first State to develop specific rules for sub-orbital flights. The US approach was to grant power for regulation and licensing over this activity to the Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST).²⁹ A 'light touch' legal approach was taken, where the main concern is public safety and safety of property. This means that sub-orbital vehicles have to be licensed like launch vehicles, and not certified like aircraft. On the other hand, passengers are required to accept the risk and may not hold operators liable in case of damage or injury. The law qualifies paying passengers as 'spaceflight participants', and operators must inform them of the risks and notify them that the US Government has not certified the vehicle as safe. Passengers must then provide their 'informed consent' in writing in order to participate in the flight.³⁰

This 'light touch' approach was chosen in order to allow the new industry to make a start. FAA/AST was in fact given a double mandate: (i) to oversee,

28 This is known as the 'Lotus principle' which says that within its territory, a State may exercise its jurisdiction in any matter, even if there is no specific rule of international law permitting it to do, subject of course to prohibitive rules of international law, or, in short, 'that which is not prohibited is permitted under international law'. *The Case of the S.S. Lotus*, 7 Sept. 1927, PCIJ Series A n. 70.

29 51 USC 50901–50923. The Commercial Space Launch Act of 1984, as amended in 2004, was re-codified in USC Title 51 ('National and Commercial Space Programs'), Ch. 509 ('Commercial Space Launch Activities') Secs. 50901–50923, available at <http://uscode.house.gov/browse/prelim@title51&edition=prelim>. The Act mandated the FAA/AST to regulate sub-orbital flights. The FAA commercial space transportation regulations are located in the Code of Federal Regulations (CFR), Title 14 ('Aeronautics and Space'), Ch. III ('Commercial Space Transportation'), available at <https://www.govinfo.gov/content/pkg/CFR-2018-title14-vol4/xml/CFR-2018-title14-vol4-chapIII.xml>. Some relevant parts are 14 CFR 401 (organization and definitions), 415 (launch license), 431 (launch and re-entry of re-usable launch vehicles-RLV's), 435 (re-entry of non-RLV's), 440 (financial responsibility) and esp. 460 (national Astronautical Congress, press, r as aviation of space he acquis communautaire'ansferred their sovereign rights to regulauman space-flight requirements). See also http://www.faa.gov/about/office_org/headquarters_offices/ast/regulations/.

30 T. Knutson, *What is 'informed consent' for spaceflight participants in the soon-to-launch space tourism industry?* 33 JSpaceL 105 (2007). It may be questionable whether injured passengers or their relatives will be bound by such letters in practice, cf. also Lyall & Larsen, *supra* n. 2 at 120.

authorize, and regulate both launches and re-entries of launch and re-entry vehicles, and the operation of launch and re-entry sites when carried out by US citizens or within the USA in order to ensure public health and safety, safety of property, and the national security and foreign policy interests of the United States, and (ii) to encourage, facilitate, and promote commercial space launches and re-entries by the private sector, including those involving space flight participants. This dual mandate may sound conflicting, but if the FAA had only been in charge of ensuring safety, a process might have resulted 'that will make sure you're safe by not letting you fly'.³¹

The US law does not define whether sub-orbital flights are space flights or something else. It regulates according to the type of vehicle involved.

3.2.2 Others

Looking at Europe, before looking at national law it is first necessary to establish whether the European Union (EU) has competence in this field or whether Member States retain their sovereign power to legislate.

With regard to space activities, the entry into force of the Treaty on the Functioning of the European Union (TFEU) in 2009 codified the competence of the EU in the field of space activities. However, the powers of the EU are limited to scientific and technological space activity and likely do not cover private commercial space activities such as sub-orbital flights. In addition, the harmonization of national space laws and regulations is prohibited under paragraph 2 of Article 189 of the TFEU.³² There is thus, for the time being, no EU competence to regulate sub-orbital flights as spaceflight, and Member States are free to regulate them as aviation or as space activity. They might consider sub-orbital vehicles more akin to spacecraft and regulate them under their national space legislation, but currently, only a few European States have adopted space legislation, and none of them addresses sub-orbital flight.³³ On the other hand, since human sub-orbital flight will be substantially carried out in airspace, it is possible that the civil aviation authorities concerned will take the lead and consider sub-orbital flights under the aviation rules, which is what happened in the UK, as will be seen *infra*.

With regard to aviation, the EU does not have an exclusive competence. The EU has established an extensive set of rules under the *acquis communautaire*.³⁴ If the EU would consider sub-orbital flight as coming under the

31 J. Foust, *Still waiting on space tourism after all these years*, The Space Review, 18 June 2018, <http://www.thespacereview.com/article/3516/1>.

32 See T. Masson-Zwaan, *supra* n. 22, and T. Masson-Zwaan & S. Freeland, *ibid.*, at 1597–1607.

33 See for a useful overview of national space legislation, <http://www.oosa.unvienna.org/oosa/en/SpaceLaw/national/state-index.html>. Only the Dutch Space Activities Act makes a brief mention to an eventual inclusion within its scope of commercial human space activities, in its Art. 2.2.b.

34 See P. Mendes de Leon, *Introduction to air law*, Ch. 3 (10th ed., Kluwer 2017).

aviation *acquis*, the EU aviation rules would become applicable, as well its competence in the field of safety regulation via the European Aviation Safety Agency (EASA). EASA would be at the forefront to ensure the safety of sub-orbital flight in Europe and might require full certification for commercial sub-orbital vehicles, instead of the licensing approach chosen by the USA, unless it decides to grant an exception for sub-orbital vehicles and applies a softer regime, as is allowed under its mandate. However, despite some initial involvement, the EU has so far not declared its intention to regulate sub-orbital flights under its aviation regime.³⁵

ESA has expressed its view on this matter in 2008, when it presented an official position paper on privately-funded sub-orbital spaceflight.³⁶ The paper provides the following definition of 'space tourism': 'the execution of sub-orbital flights by privately-funded and/or privately-operated vehicles and the associated technology development driven by the space tourism market.' ESA observed that, since sub-orbital space tourism 'will be carried out substantially in the airspace of a given country', the civil aviation authorities concerned and the competent agencies of the EU should be at the forefront for setting up a regulatory framework for space tourism in Europe. It also stated that 'since in the longer term space tourism will involve travelling to outer space, some rules of space law may find application for space tourism'. This seems to imply that ESA sees the currently foreseen sub-orbital flights as an aviation activity to which air law must be applied, and would at a later stage look at the possible application of space law for the regulation of orbital space tourism.³⁷ Since then, ESA has not given further statements on the matter.

In the meantime, the United Kingdom is the second State that has taken action to regulate sub-orbital flights. The UK presented an ambitious draft Spaceflight Bill in 2017, which led to the adoption of the Space Industry Act in March 2018, henceforth referred to as 'the Act'.³⁸ The aim of the Act is to enable the launch of small satellites from the UK, as well as sub-orbital spaceflights and scientific experiments. The first UK spaceport should be operational before 2020 and it is expected that licences for launch and sub-orbital activities will be granted around that time. The Act will be accompanied by a regulatory structure that 'empowers innovation,

35 See J.B. Marciacq e.a., *Towards regulating sub-orbital flights – an updated EASA approach*, 61st International Astronautical Congress, Prague, 2010 and J.B. Marciacq e.a., *Accommodating sub-orbital flights into the EASA regulatory system*, in J. Pelton & R. Jakhu (eds.), *Space safety regulations and standards* 187–212 (Springer 2010).

36 See press release at http://www.esa.int/esaCP/SEM49X0YUFF_index_0.html, with a link to the position paper.

37 See the event pages at the interest of all stakeholders, whether they are States, operators of passengers or of Space Law, 5) right T. Masson-Zwaan & R. Moro-Aguilar, *supra* n. 22.

38 See <https://services.parliament.uk/bills/2017-19/spaceindustrybill.html>. Following agreement by both Houses on the text of the Bill, it received Royal Assent on 15 March 2018 and the Bill is now an Act of Parliament (law).

embraces opportunity and ensures UK launch activity is carried out safely and responsibly in the UK'.³⁹

The UK Civil Aviation Authority will be in charge of licensing sub-orbital flights, and the regulations will resemble those of the US, in the sense that the safety of the uninvolved general public is the primary concern, while at the same time the intent is to not place burdens on industry that would stifle its development and growth. The concept of 'informed consent' is included in Article 17 of the Act.

As more national laws will start to address sub-orbital flights, deciding to choose either an air law approach or a space law approach, a patchwork of different rules may result, leading to flags of convenience and forum shopping. It seems desirable that some measure of harmonization takes place, in the best interest of all stakeholders, whether they are States, operators of passengers. In any case it is interesting that both the USA and the UK have decided to regulate sub-orbital flight activities in their space legislation and not in their aviation legislation.

3.3 International Law

When sub-orbital flights will eventually involve more than one State, for instance in transit or when picking up or delivering passengers or cargo, international law will apply, but it is uncertain whether this would be air law or space law. The UN space law treaties apply to relations between States in carrying out space activities, whereas international air law conventions deal with international carriage by air. There are many differences between air law and space law, mainly because air law is based on the complete sovereignty of the State over the airspace above its territory, while space law is based on the principle of freedom of use and exploration, and rules out claims of sovereignty.

The legal regime governing aviation is very elaborate, efficient and well defined in terms of liability, registration, jurisdiction, traffic- and transit rights, certification of aircraft and crew, and other matters, and the rules have been tested and clarified by jurisprudence.⁴⁰ So if sub-orbital flights were considered as aviation, there would be no major problems or lack of rules, but there may be a measure of regulatory overkill that might hinder the emerging industry. If, however it would be considered as a space activity and would consequently be governed by space law, the legal scenario will be quite different and gaps may exist, because the rules are far less detailed and mostly regulate the relations between States, and they have never been put to the test in a court case.

Perhaps in the end, the establishment of a new *sui generis* regime for sub-orbital flights, mixing elements from the air law and space law regimes, might be the preferred option.

³⁹ *Ibid.*

⁴⁰ P. Mendes de Leon, *supra* n. 34.

3.3.1 *Applying Space Law*

International space law is not very well suited to accommodate sub-orbital activities. The Outer Space Treaty did foresee that private entities would engage in space activities in Art. VI of the Outer Space Treaty, making States internationally responsible for national activities carried out by non-governmental entities, obliging them to authorize and supervise such activities. But the UN treaties do not clearly define what qualifies as a 'space object', so it is unclear whether sub-orbital vehicles could qualify as such. Likewise, the treaties only address liability at the level of the States involved, and the exposure of private operators to second- or third-party liability is not addressed.⁴¹ The only relevant references to persons on board vehicles is in Article V OST which defines them as 'envoys of mankind', and ARRA which speaks of 'personnel of a spacecraft', but does not distinguish between crew and paying passengers. Also, there is no cap on liability, and no opportunity for passengers or third parties to present claims for compensation directly to the operator. Claims must be presented by one State to another. Moreover, nationals of the launching State may be excluded altogether from presenting a claim under Article VII of the Liability Convention. This provision is inadequate for a paying passenger on board a commercial flight.

Space law also presents problems with regard to the registration of the vehicles, since Article II of the Registration Convention mentions that only objects that are launched 'into Earth orbit or beyond' are to be registered, and sub-orbital vehicles do not reach orbital velocity.

3.3.2 *Applying Air Law*

Air law forms a comprehensive legal regime, reinforced by subsequent improvements and accompanied by extensive interpretation by case law.⁴² There may be certain benefits in applying international air law to international sub-orbital flights, but this would also present difficulties.

41 Second-party or contractual liability refers to liability of the operator vis-à-vis passengers and cargo, while third-party or non-contractual (tort) liability refers to liability for damage to persons or property on the ground, who have no contractual relations with the activities of the operators.

42 The main legal instruments are the Convention on International Civil Aviation, Chicago, 7 Dec. 1944 (Chicago Convention), the Convention for the Unification of Certain Rules Relating to International Carriage by Air, Warsaw, 12 Oct. 1929 (Warsaw Convention), the Convention for the Unification of Certain Rules for International Carriage by Air, Montreal, 28 May 1999 (Montreal Convention), and the Convention on Damage Caused by Foreign Aircraft to Third Parties on the Surface, Rome 7 Oct. 1952, amended 1978 (Rome Convention). See for the Chicago Convention <https://www.icao.int/publications/pages/doc7300.aspx> and for the private air law conventions, <https://www.mcgill.ca/iasl/research/treaties/airlaw/private>. . d the event pages at t interest of all stakeholders, whether they are States, operators of passengers.ok of Space Law, 5) ight

The classic definition of 'aircraft' in the Annexes to the Chicago Convention does not adequately cover sub-orbital flights, which use rocket power. Sub-orbital flights could be regulated by air law only in case of a wide interpretation of the term 'aircraft'. This would bring legal certainty, which is essential for the industry. Another benefit is applicability of the operator-based liability system, which provides efficient protection and procedures for passengers and third parties.

Another advantage of applying air law is that sub-orbital vehicles could be registered as aircraft, whereas under the Registration Convention they cannot be registered as spacecraft, because they do not reach orbit.

Contrary to space law, air law consists of both public air law and private air law, where the former regulates aviation in respect of safety, security and traffic regulation, and the latter addresses second- and third-party liability of the operator vis-à-vis passengers and third parties on the ground. This provides a more complete set of rules to deal with various legal matters. Space law is purely public law, setting out the relations between States.

The downside of applying international air law is that operators of sub-orbital flights would have to comply with numerous rules, which may negatively impact the new industry and create heavy burdens. Air law has developed and changed considerably over the years; at first it was a State activity subject to many rules, and then gradually evolved into a privatized commercial activity requiring less protection. Sub-orbital flight is still in its infancy, and applying the full body of air law may be too demanding.

Over the years, the two UN bodies dealing with aviation and space have addressed the matter of regulating sub-orbital flights. This section provides a brief overview of their involvement.

Already in 2000, the President of the ICAO Council stated:

'The idea of adopting ICAO as a model, or expanding the mandate of ICAO to encompass outer space, has been raised before. This approach has merit. SARPs have proven effective in adapting to the dramatic transformation of civil aviation during the past 50 years or so. A global forum of nations is essential for achieving consensus on the management of outer space, and there already exists such a respected and time-honoured structure.'⁴³

And in 2005, he suggested that ICAO would be the most appropriate organisation to regulate the safety of such sub-orbital flights. A Working Paper by the ICAO Secretariat observed:

'The Chicago Convention applies to international air navigation but current commercial activities envisage sub-orbital flights departing from and landing at the same place, which may not entail the crossing of foreign airspace.

43 ICAO Journal Vol. 55, n. 7 (Sept. 2000).

Should, however foreign airspace(s) be traversed, and should it be eventually determined that sub-orbital flights would be subject to international air law, pertinent Annexes to the Chicago Convention would in principle be amenable to their regulation.⁴⁴

In 2007, the Chairman of UNCOPUOS drafted a working paper on the 'Future role and activities of the Committee on the Peaceful Uses of Outer Space', containing proposals for a future role of COPUOS in analysing and regulating sub-orbital flights.⁴⁵ Also, there have been several interventions in the Legal Subcommittee under the agenda item on the definition and delimitation of outer space, addressing the impact of sub-orbital manned flights on current space law, while the concept of 'aerospace objects' has been analysed by the Legal Subcommittee since several decades.⁴⁶

However, no concrete results have come out of the work of ICAO and UNCOPUOS so far, and the legal qualification of sub-orbital flights remains undefined until this day.

In order to make some progress, in 2015 the Directors of UNOOSA and ICAO's Air Navigation Bureau initiated the 'ICAO – UNOOSA Aero-SPACE Symposium' which took place in Montreal, Canada.⁴⁷ ICAO also set up a 'Space Learning Group' in late 2014, later joined by UNOOSA as official co-host of the group. The group has no formal status; it cannot draft standards or policies and is not a formal panel or study group. Its main activity is to share experiences and perspectives, to assess and take stock and then prepare next steps. The uniqueness of the learning group is that it integrates the aviation and space communities, and that it involves regulators, operators, lawyers, and scientists. An advantage of its informal character is that industry can also take part. The group is composed of experts appointed by Member States of ICAO and/or UNCOPUOS and representatives from several international organisations. ICAO also created a 'Space Programme' webpage, containing a list of 'Space Points of Contact & Knowledge Sharers', and documents and other resources provided by regulators, industry groups, and others engaged in the sector, searchable by State or subject.⁴⁸

The symposium permitted to share and provide an overview of existing regulations and practices as well as safety management and systems

44 C-WP/12436, Concept of Suborbital Flights, 30 May 2005, reprinted at http://www.unoosa.org/pdf/limited/c2/AC105_C2_2010_CRP09E.pdf. See also P. van Fenema, *Sub-orbital Flights and ICAO*, 30 Air and Space Law 396–411 (2005).

45 A/AC.105/L.268, 10 May 2007, http://www.oosa.unvienna.org/pdf/limited/1/AC105_L268E.pdf.

46 See n. 22.

47 See the event's website at <http://www.icao.int/meetings/space2015/Pages/default.aspx>. See for a report, T. Masson-Zwaan, *UN's Aviation and Space Bodies Meet in Montreal to Discuss Future Activities at the Intersection of Commercial Air and Space Travel*, 40 Air and Space Law 455–460 (2015).

48 See <http://www4.icao.int/space>.

engineering methods with regard to civil aviation, sub-orbital flights and developments in space transportation, to explore challenges and opportunities related to emerging space activities and provide possible ideas on how to address them, and to provide insight into space and civil aviation sectors, including who is doing what, how to get involved, and when and why aviation regulators are involved, and when they are not. A follow-up symposium was held in Abu Dhabi in 2016, and UNOOSA hosted the third event in 2017 in Vienna.⁴⁹ However, once again, no concrete results were achieved yet.

3.4 The Future

Under current international or national air or space law there is no definite answer yet about the legal status of sub-orbital flights. Also, despite all the excitement after the Ansari X-Prize, carrying humans on sub-orbital flights has proven to be more complex than initially thought. Several companies that seemed to have promising plans suffered delays or failed altogether, and possibly, the technical and financial challenges are even larger than the legal ones.⁵⁰ It seems that agreement could be found to apply part of the rules of air law to sub-orbital flights, while acknowledging their 'space' characteristics as well, so that some form of hybrid *sui generis* regime will eventually develop.

Hopefully, over time progress will be made in all related fields, so that the frontier of outer space can be made accessible to paying passengers, because the two companies that are 'leading the pack in the pursuit of space tourism say they are just months away from their first out-of-this-world passenger flights'.⁵¹

Another development is that although sub-orbital flights were initially marketed as spaceflight for private (wealthy) individuals, their potential to provide launch services for small satellites may take centre stage as a more viable business case. In 2017, Virgin Galactic even decided to create a separate company for this market, named Virgin Orbit.⁵²

When the technological and financial hurdles will have been overcome by the pioneering industries and when ticket prices will come down, the number of potential clients will certainly be high because the prospect of experiencing weightlessness and observing the 'Blue Planet' from outer space is attractive to many. Moreover, eventually, sub-orbital flights will enable intercontinental rocket transport, i.e. flying from point A to point B on Earth via outer space, thus substantially shortening travel time.

49 See the event pages at <https://www.icao.int/meetings/space2016/Pages/default.aspx> and . d the event pages at t interest of all stakeholders, whether they are States, operators of passengers.ok of Space Law, 5) ight <https://www.icao.int/meetings/space2017/Pages/default.aspx>.

50 J. Foust, *supra* n. 31.

51 I. Couronne, *supra* n. 26. See also J. Foust, *supra* n. 27.

52 See <https://virginorbit.com>.

4 CONCLUSION

Critics argue that human spaceflight is unnecessary, unsustainable, too dangerous and too costly, and all space activity can be carried out more efficiently and much cheaper by robots. The above reservations are certainly true, and sending humans into deep space will be a long time coming, but experts tend to agree that robotics and humans are both essential in exploring and using outer space: 'In what was really only a few days on the lunar surface, the Apollo astronauts produced a tremendous scientific legacy; robotic exploration of the moon and Mars pales in comparison'.⁵³

Humans can quickly react to changing circumstances and are more mobile than robots, for instance. Another argument for having both is that robots can serve as pathfinders, preparing the grounds for human presence. And an aspect that should certainly not be underestimated is the role of astronauts as ambassadors for humankind. Only about five hundred persons have been to outer space since the start of the space age, and they always come back with a changed perspective – having observed the fragility of our planet Earth, and the absence of boundaries when seen from outer space, they have a message to convey. They motivate children to study science and math, so that they might one day become astronauts.

It may be clear that human presence in outer space is essential. It is furthermore mankind's nature to push boundaries. As Konstantin Tsiolkovsky, one of the fathers of rocketry and cosmonautics, once said: 'Earth is the cradle of humanity, but one cannot remain in the cradle forever'.⁵⁴ It is therefore important to continue to study the legal aspects of human spaceflight. The ISS will certainly be followed by further collaborative manned missions, whether it is a station or a settlement on the Moon or Mars. In addition, sub-orbital flights for private individuals will most certainly happen, and legal certainty will be needed.

53 A. Mann, *Humans vs. Robots: Who Should Dominate Space Exploration?*, Wired, 4 Nov. 2012, <https://www.wired.com/2012/04/space-humans-vs-robots/>, citing I. Crawford, *Dispelling the myth of robotic efficiency: why human space exploration will tell us more about the Solar System than will robotic exploration alone*, 53 *Astronomy and Geophysics* 2.22–2.26 (2012).

54 See <https://www.nasa.gov/audience/foreducators/rocketry/home/konstantin-tsiolkovsky.html>.