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Chapter 8

Liability for Damage Caused by Small Satellites – A Non-Issue?

Frans von der Dunk

I. Introduction

As sufficiently recounted elsewhere in this book, small satellites have become a welcome addition to the existing tools to benefit from space applications—they are relatively simple and cheap to construct, and being small, relatively cheap to launch as well, as secondary payloads on launch vehicles where the primary payload may not take up all of the (often standardized) payload bay capacity. As they, moreover, usually orbit for relatively short times in low trajectories before burning up in the atmosphere, they might not seem to pose major or even merely realistic liability risks.

As a consequence, sometimes the issue of liability for damage caused by small satellites has been treated as a non-issue, or at least as an issue which in law does not present relevant novel aspects and in practice is by far *not* the most important issue in the area of liability (or vice versa in the area of small satellites). Since, however, the amount of small satellites in view of their attractiveness as indicated is rapidly growing,¹ this quick assumption might warrant a closer look. Thus, the current chapter briefly analyzes the extent to which small satellites may or might give rise to specific legal issues in the context of liability for space activities, and whether it would indeed be a non-issue.

II. International Space Law and Liability for Damage Caused by Satellites: The Framework

International space law has addressed the issue of liability for damage caused by space activities through the concept of a “space object” being at the root cause of such damage.

This is noteworthy, as commonly liability attaches to someone undertaking a certain *activity* causing damage rather than to an *object* involved in causing damage. Nevertheless, the Outer Space Treaty broadly but clearly states:

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.²

Another clause, however, provides that states remain internationally responsible for “national activities in outer space” (in particular for ensuring that these “are carried out in conformity with the provisions set forth in the [Outer Space] Treaty”),³ which under circumstances could also give rise to claims for compensation of damage as the appropriate form of reparation under general principles of public international law.⁴ Such damage would then obviously be linked directly to the *activity*, as different from the earlier clause focusing on the *object* involved instead.

These clauses—in particular of Article VII of the Outer Space Treaty—have been elaborated by the Liability Convention⁵ which again focuses on the object involved. This Convention specifies that the “object” referred to in Article VII of the Outer Space Treaty is actually a “space object,” and (although rather unsatisfactorily and incompletely) “defines” it as including “component parts of a space object as well as its launch vehicle and parts thereof.”⁶ In addition, it applies a distinction between damage caused by such space objects on Earth or to aircraft in flight respectively to other space objects in outer space: for the former, absolute liability applies, whereas for the latter liability as based on fault will determine any duty to compensate.⁷

In this respect, the Convention furthermore provides for—in principle—unlimited compensation, as the compensation should “provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.”⁸

The final key element of the Liability Convention to be noted at this juncture concerns the state-character of liability: every “State which launches or procures the launching of a space object; [and every] State from whose territory or facility a space object is launched” qualifies as an entity internationally liable for relevant damage, regardless of any private ownership of or control over launch or space object.⁹ A major consequence of this system is that individual states possibly qualifying as “launching states” are strongly stimulated to assert, through national legislation, regulation and licensing, a considerable measure of control over any private space activities which could thus give rise to those states liability being internationally asserted.¹⁰ This means that a full-fledged analysis of the specifics of small satellite operations in the context of international liability should also take on board the extent to which—and the manner in which—these clauses from the treaties have been implemented at the national level.

The above clauses obviously form the point of departure for any discussion on specific liability issues pertinent to small satellite operations.¹¹ To the extent that the aforementioned concept of the “launching state” is at issue in the context of small satellites, this discussion would also be relevant for the applicability of the Registration Convention¹² as that also crucially hinges on the qualification of the “launching state,”¹³ but that is an aspect which will not be further discussed here.

III. The Definitional Issues—of “Space Object,” “Launch,” and “Outer Space”

1 *The “Traditional” Definitions*

In the absence of any precise or even workable definition of “space object” in the relevant treaties, the first part of the question here is whether small satellites would or should be included in that term as triggering applicability of the Liability Convention in particular.¹⁴

The underlying concept of “objects” is, of course, quite clear, and small satellites without a doubt are at least “objects.” Then, as the key space treaties alternatively refer to “objects launched into outer space” (as per Article VII of the Outer Space Treaty) and to “space objects” (as per the Liability Convention and the Registration Convention), the logical equation of the former to the latter—an equation generally adhered to moreover by expert opinion¹⁵—would also encompass small space objects such as small satellites. Already in that sense, liability for (damage caused by) small satellites is an issue—but *not* one principally separate from that of liability for (damage caused by) large(r) satellites.

This conclusion is reinforced by the inclusion of “mere” component parts, which could be rather small indeed, in the concept of “(space) objects” for the purpose of the Liability and Registration Conventions.¹⁶ In that sense, at the outset size does not matter; from the perspective of the law “one size fits all.” Consequently, also small satellites piggy-backing as secondary payloads on launch vehicles would qualify as “space objects.”

Finally, if “space objects” are to be defined with reference to their being “launched into outer space,” the definitions of both “launch” and “(into) outer space” come into play. As to “launch,” it has—perhaps mostly unconsciously—been perceived as basically comprising any kind of vertical take-off effectuated with the help of rocket technology. As to “outer space,” the absence of a clear boundary between outer space and the underlying airspaces had not traditionally presented much of a problem: there was no question that the satellites at issue were operating at altitudes considered as “outer space” by most, if not all concerned.¹⁷

2 *The Challenges to the “Traditional” Definitions Posed (inter alia) by Small Satellites*

In the present context of small satellites, those definitions—with the exception of the “object” part, which clearly continues to encompass satellites of any size, unless otherwise determined—now raise certain challenges with respect to the underlying assumptions.

Firstly as to the concept of “launch.” The original, more narrow technical/operational meaning of “launch” had already been challenged ever since the mid-1980s by the air launches of the Pegasus vehicle: Orbital Sciences had the spacecraft itself released from underneath an airplane in mid-air, where the very first part of the trajectory essentially is

a horizontal one—and then those activities were (still) legally defined as “launches,” at least for the purpose of space law.¹⁸

As long as such launches at least still involved “standard” rocket technology this challenge perhaps remained marginal, and no major discussion on the relationship between the legal concept of “launch” and the “traditional” technical/operational understanding of those terms was undertaken.

Here, however, the plans of various prospective private commercial spaceflight operators to use their sub-orbital or low-Earth-orbiting vehicles under development to “bring” small satellites into very low trajectories would constitute a more fundamental challenge. Under those plans, some vehicles are two-stage-to-space, some are aerospace-plane-like single-stage-to-space; some craft take off horizontally, others vertically, still others from underneath carrier aircraft wings in mid-air—so all use different technologies as well.¹⁹

While in principle it might be debatable whether the concept of “launch” still applies to such operations (witness the many articles focusing instead on the application of air law to such flights)²⁰ a strong argument could be made that the original, limited understanding of that concept should no longer hold, and that “launch” should refer to any transport activity aimed at bringing something into outer space—which would then of course also include small satellites. As this argument, however, is not (yet) generally accepted, let alone formalized as law, the risk that major additional legal confusion would result remains, precisely where different technical devices transporting small satellites to the same low-Earth regions of outer space would otherwise fall under different regimes.

Second, where a “launch” in space law indeed, for the sake of potentially triggering the Liability Convention, refers to bringing (or at least attempting to bring)²¹ a “space object” “into outer space” regardless of the precise technical or operational means, a further salient issue would arise: the long-lasting question of where “outer space” would actually “begin” would need to be answered.²² This is in particular where, in the absence of any legal definition of “small satellites,”²³ current general assumptions regarding small satellites challenge this general traditional perception.

Most importantly, small satellites are considered to operate in (very) low Earth orbits, which means almost by definition that they operate for short periods only: such orbits are short-lived due to gravity forces and atmospheric drag.²⁴ For small satellite launches by some of the impending private suborbital flight providers this applies *a fortiori*, as their trajectories follow a parabolic single arc falling well short of an orbit.

Consequently, the issue of whether they actually enter outer space by being separated from their transportation vehicle at 80, 100, 120, or 150 km altitudes is now indeed becoming an issue—at least in as far as one considers small satellites to present realistic risks to other space activities and objects operating in the same zones. The presence of the satellites at such altitudes does not merely concern a marginal and transitory phase on their way to orbit but their ultimate and planned orbit respectively trajectory.

For a proper understanding, furthermore, of the risks which small satellites may present in terms of liability, whether or not distinct from those presented by other space objects or space operations, this brings analysis to a scrutiny of the other current perceptions concerning small satellites specifically related to liability—which warrant being scrutinized as well.

3 The Perception of Liability Risks in the Context of Small Satellites

As the satellites under consideration by definition are small, the general perception is that the risk of such satellites causing damage is marginal enough not to warrant worrying about liability issues—due to their size they will not survive re-entry, and due to their low and short-duration in-flight life will be very unlikely to encounter any other space object before such re-entry.

Traditionally, moreover, most or all of them were operated for scientific rather than commercial purposes. It could thus be assumed that liability issues would largely tend to be neglected. To the extent that it would be envisaged in the first place that the experiment would suffer damage because of another similar scientific satellite happening to come too close, that might rather be perceived as a “natural” risk not warranting paying attention to third-party liability, as being “all in the game.”

Furthermore, such satellites would by and large not have room for anything other than the (usually experimental) payload and a small downlink transmission device, and generally even lack fundamental flight control and adjustment capabilities. As will be seen, this has even given rise to national regulation effectively perceiving such satellites not to be “real” space objects.²⁵ Since, it was reasoned, those small satellites were unguided, even uncontrollable, after separation from their launch vehicles, they would not as such give rise to potential liability under the Liability Convention for damage caused by them. Thus (at least originally) these laws excluded such satellites from national licensing and attendant third-party liability coverage obligations.²⁶

This perception is, however, rather misguided already legally speaking. Even “space debris,” the ultimate in non-controllable, non-guidable objects in outer space, has by now been generally accepted to qualify as “space objects” for the purpose of the Liability Convention.²⁷ It would not make sense therefore to allow for escaping from liability for damage caused by small satellites—contrary to “space debris” the result of a conscious action—merely because of their lack of guidance or control after separation from the launch vehicle.

What is more, with the rapidly increasing numbers of small satellites operating and envisaged to operate in the lowest regions of what might be considered outer space the whole risk paradigm changes. The likelihood that such satellites may, after all, interfere with other satellites in a harmful manner (and not just with a scientific experiment but with commercially valuable payloads) is increasing exponentially. Even more profoundly, many of them will be launched into the same lowest regions of outer space where soon the first suborbital tourists are expected to be launched (often moreover by the same operators), which should obviously raise awareness of damage and liability risks by a notch or two. Since it would be rather difficult, as argued, to hold that small satellites would *not* be covered by the Liability Convention, liability would by that token certainly be an issue also for small satellites in that context—even if not as such separate from larger space objects.

4 Revisiting the Boundary Question

In sum: the risks of damage caused by small satellites is rising rapidly, which also means that the current uncertainties about applicability and application of liability regimes should be solved. Ideally, there should be no question that all such satellites are space objects in the sense of the space treaties, in particular the Liability Convention, which means most

importantly that regardless of the technology used, they must be considered to be launched into outer space in the sense of those treaties—which again, in turn, means that the boundary question of where airspace gives way, vertically speaking, to outer space, needs to be solved.

What thus may long have seemed an issue of largely theoretical importance, is now back on the table if one wishes to provide a clear legal guiding line between small satellites that would be subject to space law as space objects, and other small objects which would never reach that threshold. This is not the place to substantively revisit the longstanding discussion on the issue²⁸ nor the present author's particular arguments and conclusions.²⁹ Suffice it to say here that there would seem to be a gradually increasing convergence of opinion that such a borderline should be accepted at an altitude of 100 km or thereabout above the Earth's surface, but that without the explicit or tacit consent of the United States, as the strongest space power of today and the one also most prominently involved in sub-orbital and low-Earth-orbital spaceflight projects, it would seem premature to conclude that this would have reached the status of customary international law.

Nevertheless, not solving this issue may mean that in the context of small satellites each time arguments may be advanced both *pro* and *contra* as to whether the satellite at issue would constitute an "object intended to be launched into outer space," hence giving rise to liability under the Liability Convention. This problem may become further compounded by the possibility that victims may seek alternative remedies in the absence of perceived (clarity of) application of the Liability Convention.

Firstly, Article VI of the Outer Space Treaty, addressing that twin brother of "liability" labeled "responsibility," may come into play here. In the absence of unequivocal and unchallenged guidance on the relationship between Article VII of the Outer Space Treaty plus the Liability Convention on the one hand and Article VI of the Outer Space Treaty on the other, states victim of activities by small satellites may be tempted to invoke the latter clause to avoid the above disputes. Following the general public international law concept of "state responsibility"³⁰ they might claim "reparation" would be due under Article VI for "national activities in outer space" if these would be in violation of the Outer Space Treaty (and by proxy, courtesy Article III of the Treaty,³¹ of all of international space law). This, in turn, may come to include material compensation as the proper form of reparation in case said violation results in damage—whether the latter would be compensable under the Liability Convention or not. In this context in particular the general principle of international law *sic utere tuo ut alienum non laedas* with the resulting obligation to compensate for damage caused may also be invoked, as evidenced already early on by the famous Trail Smelter arbitration.³²

Secondly, liability for damage caused by small satellites could also be claimed before national juridical instances—note again that the Liability Convention expressly allows that to happen: "Nothing in this Convention shall prevent a State, or natural or juridical persons it might represent, from Pursuing a claim in the courts or administrative tribunals or agencies of a launching State."³³ As, in such cases also, the same issues of the extent in which a small satellite would fall under the Liability Convention (in particular as implemented by national laws and licensing regimes) would come up, it becomes appropriate to address the extent to and manner in which national space laws in the course of such

implementation of the Convention have addressed the issue. For the present purpose, this analysis will be limited to the extent and manner in which those national space laws have referenced the possibility of small size objects being launched whose operations should be licensed and/or have substantially addressed the two key definitional issues addressed before, of “launch” and “(into) outer space.”

IV. National Implementation—Addressing the Launch and Size of Objects Launched into Outer Space

1 The United States

In the United States, the licensing of private space operators *inter alia* for the purpose of implementing the space treaties specifically distinguishes between, and consequently legally separates, the launch and the operation of satellites. The latter are predominantly dealt with by the FCC under the latest version of the 1934 Communication Act³⁴ as for telecom satellites and by NOAA under the 1992 Land Remote Sensing Policy Act³⁵ as far as remote-sensing satellites are concerned. Since those Acts are concerned with certain types of in-space operations, the size of the hardware undertaking those operations or how such hardware was transported to its operational area is basically irrelevant.

It is, consequently, the US national launch legislation which should be scrutinized in order to determine whether it has to any appreciable extent addressed the issues of what a “launch (into outer space)” would be, and whether the size of a satellite or the level of control over it matter in the context of licensing such launches.

As it turns out, the Commercial Space Launch Act of 1984, as crucially amended in 1988 and 2004,³⁶ does not distinguish at all as regards size or level of control of satellites. In line with the US approach of refusing to acknowledge a particular boundary between airspace and outer space or even the need for such a boundary at all, furthermore, the Act basically skirts the delimitation issue. Licenses are also required for air-launched and/or sub-orbital craft regardless of technology used or altitude aimed for, as long as those are considered (at least ultimately) to be designed for use in outer space.³⁷ The FAA, for instance, also licensed certain high-altitude balloon flights contemplated by Paragon targeting an altitude of “only” 30 km because the ultimate aim was to test vehicle technology for future use in space.³⁸

Consequently, under this legislation small satellites under the US system are subject to the licensing regime without further ado. While the result of this straightforward approach is that the discussions on “launch” and “outer space” as concepts are aptly circumvented, with a view to the *international* definitional issues as discussed before US law is thus rather unhelpful in resolving them. It thus also remains to be seen whether problems may result from the disconnect between us law and international law, both space law and aviation law, in these respects.

2 Sweden

Sweden is a country interesting from the perspective of small satellites *inter alia* because of its launch site at a very northerly location, in Kiruna—a remote area made for polar orbits, which are of particular interest to science. The 1982 Act on Space Activities provides for

the fundamental licensing obligation—for space *activities* undertaken either from Sweden or by Swedish nationals or entities.³⁹ In other words: it does not mention “space objects” as such, let alone with any specific reference to size or altitude.

The Act at the same time does exclude among others the launch and operation of “sounding rockets” from the scope of this licensing obligation.⁴⁰ As sounding rockets typically concern sub-orbital launches on small launch vehicles for scientific purposes, where often the payload does not even separate from the launcher, the Swedish legislation thus *does* seem to exclude a major category of small satellites from its licensing system, but as based upon their scientific mission—instead of their size.

3 South Africa

Also the 1993 South African Space Affairs Act does not focus directly on “space objects” — although it does define “spacecraft” as “any object launched with the purpose of being put and operated in outer space”⁴¹—but focuses on licensing space activities instead, defined as “the activities directly contributing to the launching of spacecraft and the operation of such craft in outer space.”⁴²

Here, it then distinguishes between launching into a “sub-orbital trajectory” and launching “into outer space” (defined as per lowest perigee) in its definitional Section⁴³— yet it does not principally differentiate in the application of the licensing system, as the Act provides: “(a) any launching from the territory of the Republic; [and] (b) any launching from the territory of another state by or on behalf of a juristic person incorporated or registered in the Republic” require a license under the Act, without any principled reference to size or purpose of the satellite.⁴⁴ A distinction without a difference, in other words: small satellites would be included in principle just as much as large ones.

4 Australia

Australia presents an interesting case in that its national space law actually tried to define outer space in quite precise terms, an example so far followed only at a national level by Kazakhstan.⁴⁵ Further to the 2002 Amendments⁴⁶ to the 1998 Act,⁴⁷ “launch” is now defined with reference to bringing a “space object” to a 100 km altitude or above.⁴⁸

Thus, though it does not provide anything with regard to the size of satellites—as “space object” is defined mainly also with reference to that altitude⁴⁹—this clear cut-off point as regards the applicability of the licensing system under the Act⁵⁰ would mean that any small satellite or other payload destined for operations below such an altitude would not fall within the scope of the licensing obligations. On the other hand, the Australian law thus provides the strongest example of taking the logic of the Liability Convention’s key concepts of “launch” and “outer space” to its ultimate conclusion.

5 Brazil

In 2001, Brazil enunciated its basic national space law by way of an Edict and attendant Regulation.⁵¹ The Regulation does not as such use the word “space object,” but refers to “the launching of satellites and other kinds of orbital and sub-orbital payloads, by means of launch vehicles, including the preparation and conduction of the operation.”⁵² In other words, size still does not matter, at least in principle.

More or less like the South African Act, the Regulation does thus distinguish between “orbital” and “sub-orbital payloads,” but does not differentiate as to the applicability of the licensing requirement with respect to either; neither does it provide for any guidance on where outer space as such begins.⁵³ It may of course well be that in the actual implementation process this distinction will also lead to a difference, whereby sub-orbital payloads would by nature come to encompass many—but certainly not all—small satellites, but as of yet no data are available in this regard.

6 Belgium

The 2005 Belgian Law on the Activities of Launching, Flight Operations or Guidance of Space Objects, interestingly, limits the scope of its licensing obligation generically to the “launching, flight operations and guidance of space objects.”⁵⁴

The latter are defined in a rather broad sense, as comprising “any object launched or intended to be launched into outer space, including the material elements composing that object.”⁵⁵ In other words, neither the size of the object to be launched *per se*, nor the altitude at which it is aimed to be launched, matters. On the other hand, the reference to “outer space” indicates that in that sense the delimitation issue is indeed important in determining the applicability of the licensing system—but no specific altitude is implicated or indicated.⁵⁶

At the same time, as many small satellites would likely be “unguided” after release from the launch vehicle (they would merely transmit radio signals to the ground), under this approach their operation would *not* require a (separate) license. In view of this uncertainty, the Belgian legislator saw the need to amend the law.⁵⁷ The new text now extends the obligation to obtain a license for activities involving space objects “which cannot be guided once positioned in orbit.”⁵⁸ With this clarification, small satellites are now without further doubt qualified as “space objects” under the Law, and consequently entail for example the possibility for triggering liability under the Liability Convention for damage caused by their operations.

7 The Netherlands

The Netherlands in its 2007 Law⁵⁹ originally followed the Belgian approach, in limiting the scope of its licensing obligations to “the launch, the flight operation or the guidance of space objects in outer space.”⁶⁰ Likewise, it defined a “space object” identically to the Belgian Law, leading to the same conclusions as in that case.⁶¹

Problems however then arose with regard to intended operations by the Dutch company ISIS, which wanted to have CubeSats launched and wanted to do so within the framework of a licence.⁶² As a consequence, however, the Dutch Law was complemented, in 2015, by an administrative measure issued by the King, making clear that also “unguided” satellites should fall under the scope of application of the Dutch Space Act.⁶³ Already before this measure, most commentators were in agreement that regardless of the applicability of the Dutch Law to such operations, the moment unguided small satellites would qualify as “space objects” in accordance with international definitions it would be rather difficult for the Netherlands to disavow liability merely on the grounds of such space objects being “unguided.”⁶⁴

8 Austria

Austria in its 2011 Law on the Authorisation of Space Activities and the Establishment of a National Space Registry limited the scope of the licensing obligation to “the launch, operation or control of a space object.”⁶⁵ “Space object” is defined as “an object launched or intended to be launched into outer space,” without however defining the latter in any sense.⁶⁶ As the Austrian Outer Space Act has been enacted precisely to address the need for regulation of small satellites, namely Austria’s first nanosatellites in the BRITE constellation,⁶⁷ it is generally applicable to small satellite projects. It even contains an incentive for small satellite projects, as far as they are “in the public interest,” that is research or education, because those are eligible for a reduction or a waiver of the obligation to get insurance.⁶⁸

9 Kazakhstan

Kazakhstan, in 2012, was the latest state enunciating a national space law.⁶⁹ The country, of course, encompasses the site of the famous spaceport of Bajkonour, in the days of the Soviet Union responsible for the most spectacular launches and still in operation as a Russian spaceport under lease from Kazakhstan.⁷⁰

The Kazakh Law applies the licensing obligation, in line with most other national acts, to any “activity [. . .] in the field of outer space use,” such activities moreover being extensively understood.⁷¹ Likewise, no details on specific size or purpose of space objects involved are given. The main interesting feature from this perspective is that the Law defines “outer space” as the “space extending beyond the airspace at an altitude of more than one hundred kilometres above the sea level.”⁷²

10 Other National Space Laws

In the other generic national space laws which provide for some form of licensing or authorization regime with respect to space activities there is no relevant reference whatsoever, direct or indirect, to the purpose or size of satellites involved in such activities, only to the underlying concept of “launch” into “outer space” without any further detail or clue as to how those concepts should be considered defined. This applies to Norway,⁷³ the United Kingdom,⁷⁴ the Russian Federation,⁷⁵ Ukraine,⁷⁶ South Korea,⁷⁷ and France.⁷⁸

One should note, however, that the general framework-character of these laws would certainly allow for individual exceptions, for example in case certain licensing obligations are not deemed necessary from the perspective of the international obligations, public policy, or safety interests of the respective licensing states. This also holds true for all the other national space laws discussed, except perhaps the us one as this has meanwhile been rather extensively elaborated in implementing regulations.

From that perspective, further investigation and analysis of state practice on the issue might well be necessary, although the Belgian, Dutch, and Austrian examples so far rather seem to point in the direction opposite from any fundamental separation of small satellites from large satellites, and to rather comprehensively include even small satellites that are not “guidable” post-separation in the scope of the licensing requirements applicable to all other satellites.

V. Conclusions

So far, at the highest level no other conclusion is possible than that small satellites are indeed principally covered by the Liability Convention, and from that perspective do not warrant any fundamentally different approach from a liability perspective; for the Convention size does not matter. While perceptions about small satellites have so far perhaps allowed neglecting the resultant liability, as argued those perceptions do no longer hold true on various fronts: liability for small satellites is an issue but not principally separate from liability for large satellites.

At a secondary level, however, it has to be realized that the Convention's across-the-board applicability to small satellites effectively only holds true to the extent that these are to be considered "launched into outer space." Thus, courtesy of the ongoing increase in small satellite operations it now becomes important to ensure that the concept of "launching" in this context is clearly and broadly defined as ignoring the specific technologies or operational procedures which are used, and that the concept of "outer space" should now also, finally, become delineated in a "geographical" sense.

Further complicating matters from the perspective of arriving at a clear and common understanding of those concepts, however, most national space laws do not even take the same approach in this regard, as they focus rather on licensing of certain (space) *activities*, regardless of the satellites involved in them (and without defining the "space" part of such activities in any detail), than on those objects as such. If referencing the concept of "space object," however, size as such is *never* a distinguishing factor.

Moreover, a considerable number of those laws include flights as such not even intended to reach outer space (United States) or distinguish between "sub-orbital" and other flights without, however, making clear where a real difference may result from the distinction (South Africa, Brazil). Australia, Kazakhstan, and Sweden from that perspective are the most straightforward: the former two explicitly refer to the altitude of 100 km as decisive for applicability of most of the clauses of the respective acts, whereas the latter explicitly excludes sounding rockets from its own scope.

Of course, as indicated, *de facto* the risks of causing damage and hence incurring liability may be of a rather different size as between small satellites and large satellites. Yet, while perhaps as of today still only a small number of "small" satellites with very low orbital or even sub-orbital trajectories and a short lifetime before burning up in the upper atmosphere would be at issue, this is likely to change profoundly in the near future. As many national laws allow for fine-tuning to the risks of individual launches including those of small satellites, there might not be a broad necessity to overhaul present national legal frameworks to deal appropriately with those rapidly growing risks—at least, if sufficient awareness of those risks is present!—but it is clearly not a *non-issue*. And to the extent for example the current discussion in the Netherlands evidences lack of clarity and certainty on international concepts such as "space object," as triggering the applicability of the Liability Convention on the international level, a considerable measure of further clarification, preferably even harmonization, of those international concepts remains desirable.

Notes

1. See, for example, elsewhere in this book the chapters by Michael Dornik and Milton Smith, Olga Volynskaya and Rustam Kasyanov, Romina Acevedo and Roberto Becerra, Hiroyuki Kishindo, and others.
2. Art VII Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, done 27 January 1967, entered into force 10 October 1967, 610 UNTS 205, 6 ILM 386 (1967), hereafter Outer Space Treaty.
3. Art VI Outer Space Treaty. See in general Michael Gerhard, "Article VI" in Stephan Hobe, Bernhard Schmidt-Tedd, and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol I* (Carl Heymanns Verlag 2009) 103.
4. See for a detailed analysis of this issue, for example, Frans von der Dunk, "Liability versus Responsibility in Space Law: Misconception or Misconstruction?" in AIAA (ed), *Proceedings of the 34th Colloquium on the Law of Outer Space* (AIAA 1992) 363; Bin Cheng, *Studies in International Space Law* (OUP 1997) 603, 632; Marco Pedrazzi, "Outer Space, Liability for Damage" in Rüdiger Wolfrum (ed), *Encyclopedia of Public International Law, Vol VII* (OUP 2012) 1109.
5. Convention on International Liability for Damage Caused by Space Objects, done 29 March 1972, entered into force 1 September 1972, 961 UNTS 187, 10 ILM 965 (1971), hereafter Liability Convention. See in general, for example, Lesley Jane Smith, Armel Kerrest, and Fabio Tronchetti, "The 1972 Convention on International Liability for Damage Caused by Space Objects" in Stephan Hobe, Bernhard Schmidt-Tedd, and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol II* (Carl Heymanns Verlag 2013) 83; Carl Q Christol, *The Modern International Law of Outer Space* (Pergamon Press 1984) 59.
6. Art I(d), Liability Convention; see also Art II-V.
7. See Art II resp. III Liability Convention.
8. Art XII Liability Convention.
9. Art I(c) Liability Convention; see further Art II-V.
10. See on this, for example, Irmgard Marboe and Florian Hafner, "Brief Overview over National Authorization Mechanisms in Implementation of the UN International Space Treaties" in Frans von der Dunk (ed), *National Space Legislation in Europe* (Martinus Nijhoff Publishers 2011) 29; Elisabeth Back Impallomeni, "Necessities for the Development of National Space Law" in Christian Brünner and Edith Walter (eds), *Nationales Weltraumrecht/National Space Law* (Böhlau 2008) 28.
11. Note that the Liability Convention as per Art XI explicitly disclaims any status as sole remedy, although the alternative remedies addressed by that clause are exclusively domestic in character.
12. Convention on Registration of Objects Launched into Outer Space, done 14 January 1975, entered into force 15 September 1976, 1023 UNTS 15, 14 ILM 43 (1975), hereafter Registration Convention. See in general, for example, Bernhard Schmidt-Tedd and others, "The 1975 Convention on Registration of Objects Launched into Outer Space" in Stephan Hobe, Bernhard Schmidt-Tedd, and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol II* (Carl Heymanns Verlag 2013) 227; Carl Q Christol, *The Modern International Law of Outer Space* (Pergamon Press 1984) 213.
13. 13 Art I(c) and II Registration Convention jointly determine that the "State of registry," being the or a "launching State" of the space object concerned, is the state subject to the rights and obligations provided by the Convention; the "launching State" as per Art I(a) is defined in exactly the same terms as under Art I(c) Liability Convention. See the discussion of this issue with a particular focus on the Netherlands in the chapter by Tanja Masson-Zwaan in this book.

14. At the time of drafting the Outer Space Treaty and Liability Convention, the technology to successfully build, launch, and operate what is currently understood by “small satellites” orbiting at very low orbital altitudes for a short period of time was not available, nor did such operations seem to make much sense; it would thus be fair to say that the Liability Convention was very much drafted with relatively large space objects in mind.
15. See, for example, Manfred Lachs, *The Law of Outer Space* (first published 1972, Martinus Nijhoff Publishers 2010) 65; Michael Chatzipanagiotis, *The legal status of space tourists in the framework of commercial suborbital flights* (Carl Heymanns Verlag 2011) 20; Bin Cheng, *Studies in International Space Law* (OUP 1997) 324, 493.
16. See Art 1(d) Liability Convention, resp. Art I(b) Registration Convention.
17. The limited national claims to portions of the geostationary orbit at 35 786 km following the 1976 Bogota Declaration were never broadly accepted by the overwhelming majority of states and are thus more of a footnote in the history of the boundary-discussion. See further, for example, Steven Freeland and Ram Jakhu, “Article II” in Stephan Hobe, Bernhard Schmidt-Tedd, and Kai-Uwe Schrogl (eds), *Cologne Commentary on Space Law, Vol I* (Carl Heymanns Verlag 2009) 55; Steven Freeland, “The Impact of Space Tourism on the International Law” in AIAA (ed), *Proceedings of the 48th Colloquium on the Law of Outer Space* (AIAA 2006) 187, n 17; Marietta Benkö and Engelbert Plescher, *Space Law—Reconsidering the Definition/Delimitation Question and the Passage of Spacecraft through Foreign Airspace* (Eleven International Publishing 2013) 41.
18. Cf, for example, Bin Cheng, “The Legal Regime of Airspace and Outer Space: The Boundary Problem, Functionalism versus Spatialism: The Major Premises” (1980) 5 *Annals of Air and Space Law* 323; Frans von der Dunk, “Space for Space Law? Spatialism and Functionalism Revisited” in Karl-Heinz Böckstiegel (ed), *Perspectives of Air Law, Space Law, and International Business Law for the Next Century* (Carl Heymanns Verlag 1996) 63; Thomas Neger and Edith Walter, “Space Law—an Independent Branch of the Legal System” in Christian Brünner and Alexander Soucek (eds), *Outer Space in Society, Politics, and Law* (Springer 2011) 237. Such launches were consequently, as far as US law was concerned, regulated under the Commercial Space Launch Act, 30 October 1984, Public Law 98-575, 98th Congress, H.R. 3942; 98 Stat. 3055; *Space Law—Basic legal Documents*, E.III.3.
19. Cf further, for example, Frans von der Dunk, “The integrated approach—Regulating private human spaceflight as space activity, aircraft operation, and high-risk adventure tourism” (2012) 92 *Acta Astronautica* 199.
20. Examples are Stephan Hobe and Jürgen Cloppenburg, “Towards a New Aerospace Convention?—Selected Legal Issues of “Space Tourism” in AIAA (ed), *Proceedings of the 47th Colloquium on the Law of Outer Space* (AIAA 2005) 377; H. Peter van Fenema, “Suborbital Flights and ICAO” (2005) 30 *Air and Space Law* 399; Ruwnatissa Abeyratne, “Space Tourism—Parallel Synergies between Air and Space Law?” (2004) 53 *Zeitschrift für Luft- und Weltraumrecht* 184.
21. Note that Art I(b) Liability Convention, determines that “[t]he term ‘launching’ includes attempted launching.”
22. With the large space objects originally envisaged by the Liability Convention, this would in principle of course be equally true, but as these were supposed to orbit at altitudes few would contest constituted outer space—even as they might include low Earth orbits—the precise demarcation of outer space for these purposes did not present a major issue.
23. There is no single reference in the space treaties to the concept of “small satellites,” nor is there for example such a reference in the key treaties providing the legal framework for the international use of radio frequencies by satellites: the ITU Constitution (Constitution of the International Telecommunication Union, done 22 December 1992, entered into force 1 July 1994, 1825

- UNTS I, meanwhile repeatedly amended); the ITU Convention (Convention of the International Telecommunication Union, done 22 December 1992, entered into force 1 July 1994, 1825 UNTS I, meanwhile repeatedly amended); and the Radio Regulations (for the edition of 2012 see <http://www.itu.int/pub/R-REG-RR-2012>).
24. Thus, the life-time of low Earth orbiting small satellites is generally reckoned in weeks or months, certainly not years.
 25. See further below IV.6 and IV.7.
 26. Note, of course, that any absence of a licensing regime does not *ipso facto* do away with any obligation of the state to compensate damage caused in an international context by a relevant small satellite, as long as that state would qualify as a “launching state” under the Liability Convention.
 27. Cf already Howard Baker, *Space Debris: Legal and Policy Implications* (Martinus Nijhoff Publishers 1989) 61; George Hackett, *Space Debris and the Corpus Iuris Spatialis* (Editions Frontieres 1994) 53.
 28. For those interested, reference may be had, for example, to Marietta Benko and Engelbert Plescher, *Space Law – Reconsidering the Definition/Delimitation Question and the Passage of Spacecraft through Foreign Airspace* (Eleven International Publishing 2013) 38; Bin Cheng, *Studies in International Space Law* (OUP 1997) 425, 645; Gbenga Oduntan, “The Never Ending Dispute: Legal Theories on the Spatial Demarcation Boundary Plane between Airspace and Outer Space” (2013) 1 Hertfordshire Law Journal 64.
 29. For those interested, reference may be had, for example, to “Beyond What? Beyond Earth Orbit? . . . ! The Applicability of the Registration Convention to Private Commercial Manned Sub-Orbital Spaceflight” (2013) 43 California Western International Law Journal 269; “The Sky Is the Limit—But Where Does It End?” in AIAA (ed), *Proceedings of the 48th Colloquium on the Law of Outer Space* (AIAA 2006) 84.
 30. See on this again Frans von der Dunk, “Liability versus Responsibility in Space Law: Misconception or Misconstruction?” in AIAA (ed), *Proceedings of the 34th Colloquium on the Law of Outer Space* (AIAA 1992).
 31. Art III Outer Space Treaty provides that general public international law applies to outer space, which following the principle *lex specialis derogat lege generali* mainly applies where the specifics of space law do not offer an unequivocal answer to a legal question.
 32. See *Trail Smelter Arbitration Case (United States vs Canada)* 1941, RIAA 1905.
 33. Art XI(2) Liability Convention.
 34. Communications Act, 19 June 1934, 47 U.S.C. 151 (1988), 48 Stat. 1064; cf also Communications Satellite Facilities, *First Report and Order*, 22 FCC 2d 86 (1970) Appendix C, 1. See further, for example, Petra Vorwig, “Regulation of Satellite Communications in the United States” in Ram Jakhu (ed), *National Regulation of Space Activities* (Springer 2010) 421.
 35. Land Remote Sensing Policy Act, 28 October 1992, Public Law 102-555, 102nd Congress, H.R. 6133, 15 U.S.C. 5601, 106 Stat. 4163. See further, for example, Eligar Sadeh, “Politics and Regulation of Earth Observation Services in the United States” in Ram Jakhu (ed), *National Regulation of Space Activities* (Springer 2010) 443.
 36. 51 U.S.C. ch 509, Commercial Space Launch Activities.
 37. See Sec 50905 juncto Sec 50902 sub (4), 51 U.S.C.
 38. See letter FAA to P. L. Meredith, 26 September 2013, [http://www.faa.gov/about/office_org/headquarters_offices/agc/pol_adjudication/agc200/interpretations/data/interps/2013/meredith-zuckertscoutt&rasenberger%20-%20\(2013\)%20legal%20interpretation.pdf](http://www.faa.gov/about/office_org/headquarters_offices/agc/pol_adjudication/agc200/interpretations/data/interps/2013/meredith-zuckertscoutt&rasenberger%20-%20(2013)%20legal%20interpretation.pdf)

39. See Sec 3, 1, Act on Space Activities, 1982: 963, 18 November 1982, *National Space Legislation of the World*, Vol I (2001) 398; *Space Law—Basic Legal Documents*, E.II.1; 36 *Zeitschrift für Luft- und Weltraumrecht* (1987) 11.
40. See Sec I Act on Space Activities, 1982: 963, 18 November 1982.
41. Sec 1, 20th bullet, Space Affairs Act, 6 September 1993, assented to on 23 June 1993, No 84 of 1993, Statutes of the Republic of South Africa—Trade and Industry, Issue No 27, 21–44, *National Space Legislation of the World*, Vol I (2001) 413.
42. *Ibid* Sec 1, 19th bullet.
43. *Ibid* Sec 1, 10th, 15th, and 24th bullets.
44. *Ibid* Sec 11(1).
45. See further below IV.9.
46. Space Activities Amendment Act, An Act to Amend the Space Activities Act (1998, No 100 of 2002, assented to 10 November 2002), http://www.austlii.edu.au/au/legis/cth/num_act/saaa2002247/
47. An act about space activities, and for related purposes, No 123 of 1998, assented to 21 December 1998, *National Space Legislation of the World*, Vol I (2001) 197.
48. See *ibid* Sec 8, 16th bullet.
49. Cf *ibid* Sec 8, 35th bullet.
50. See further, for example, *ibid* Sec 11–14.
51. Administrative Edict No 27, 20 June 2001, *National Space Legislation of the World*, Vol II (2002) 377.
52. *Ibid* Art 1(1).
53. See *ibid*.
54. Art 2(1) juncto Art 4(1), Law on the Activities of Launching, Flight Operations or Guidance of Space Objects, 17 September 2005, adopted 28 June 2005, *Nationales Weltraumrecht/National Space Law* (2008) 183.
55. *Ibid* Art 3(1).
56. *Ibid* Art 3(1).
57. See “Projet de loi relative aux opérations spatiales. Examen des articles” of 10 November 2012, see the website of the Belgian Senate, www.senat.fr/rap/107-161/107-1613.html. The consolidated text of the Belgian Space Law as revised by the Law of 1 December 2013 is published in the Belgian Official Journal of 15 January 2014; for the English translation see www.belspo.be/belspo/space/doc/beLaw/Loi_en.pdf. See also Irmgard Marboe, “National Space Legislation,” in Frans von der Dunk and Fabio Troncchetti (eds) *Handbook of Space Law* (Edward Elgar Publishing 2015) 127, 161.
58. Art 3, No 2, of the Belgian Space Law, as amended. See in more detail the chapter by Sa’id Mosteshar and Irmgard Marboe in this book.
59. Law Incorporating Rules Concerning Space Activities and the Establishment of a Registry of Space Objects, 24 January 2007, 80 *Staatsblad* (2007) I; *Nationales Weltraumrecht/National Space Law* (2008) 201.
60. *Ibid* Sec 1(b) juncto Sec 3.
61. *Ibid* Sec 1(c).
62. For more details about the case of ISIS B.V., see the chapter by Neta Palkovitz in this book.
63. “Besluit ongeleide satellieten,” Dutch *Staatsblad* of 28 January 2015, <https://zoek.officielebekendmakingen.nl/stb-2015-18.html>. See in more detail on the Dutch situation the chapter by Tanja Masson-Zwaan in this book.

64. See further the chapter by Tanja Masson-Zwaan in this book.
65. Art 2(1), juncto Art 3, Federal Law on the Authorisation of Space Activities and the Establishment of a National Space Registry (*Bundesgesetz über die Genehmigung von Weltraumaktivitäten und die Einrichtung eines Weltraumregisters*), Federal Law Gazette of 27 December 2011 (BGBl I Nr. 132/2011); see the English translation in 61 *Zeitschrift für Luft- und Weltraumrecht* (2012) 37–42, 56–61 and on the UNOOSA website <http://www.oosa.unvienna.org/pdf/spacelaw/national/austria/austrian-outer-space-actE.pdf> (hereafter Austrian Outer Space Act).
66. *Ibid* Art 2(2).
67. See the English translation of the Explanatory Report by the government to the Austrian parliament to the draft of the new Outer Space Act in: Irmgard Marboe, *The New Austrian Outer Space Act*, 61 *Zeitschrift für Luft- und Weltraumrecht* (2012) 26, 42 ff. See the German original at the website of the Austrian parliament http://www.parlament.gv.at/PAKT/VHG/XXIV/I/I_01466/fname_232781.pdf
68. See Art 4 para 4 (letter 8) of the Austrian Outer Space Act.
69. Law of the Republic of Kazakhstan on Space Activities, of 6 January 2012, 2012 No 528-IV http://www.oosa.unvienna.org/pdf/spacelaw/national/kazakhstan/528-IV_2012-01-o6E.pdf
70. See Treaty between the Government of Russia and the Government of the Republic of Kazakhstan on the Leasing of the Baikonour-Complex, of 10 December 1994. See also Mahulena Hosková, “The 1994 Baikonour Agreements in Operation” in AIAA (ed), *Proceedings of the 42nd Colloquium on the Law of Outer Space* (AIAA 2000) 265.
71. Art 13 juncto Art 4, Law of the Republic of Kazakhstan on Space Activities, of 6 January 2012, 2012 No 528-IV.
72. *Ibid* Art 1(6).
73. See Sec 1, Act on launching objects from Norwegian territory into outer space, No 38, 13 June 1969, *National Space Legislation of the World*, Vol I (2001) 286: “it is forbidden to launch any object into outer space” without permission from the Norwegian government.
74. See Sec 1, 3, Outer Space Act, 18 July 1986, 1986 Chapter 38, *National Space Legislation of the World*, Vol I (2001) 293; *Space Law—Basic Legal Documents*, E.I; 36 *Zeitschrift für Luft- und Weltraumrecht* (1987) 12: “(a) launching or procuring the launch of a space object; (b) operating a space object; (c) any activity in outer space” all require a UK government license.
75. See Art 2(1), 9, Law of the Russian Federation on Space Activities, No 5663-1, 20 August 1993, effective 6 October 1993, *National Space Legislation of the World*, Vol I (2001) 101: “any activity immediately connected with operations to explore and use outer space” requires a Russian license.
76. See Art 1, 10, Law of the Ukraine on Space Activities, No 502/96-VR, 15 November 1996, *National Space Legislation of the World*, Vol I (2001) 36: activities involving the “use of outer space” are subject to licensing requirements under the Law.
77. See Art 2(c), Space Development Promotion Act, Law No 7538, of 31 May 2005, entered into force 1 December 2005, unofficial translation 33 *Journal of Space Law* (2007) 175: “‘space object’ means an object designed and manufactured for use in outer space” for the purposes of the Act.
78. See Artt 1(3), 2(3), Law on Space Operations (*Loi relative aux opérations spatiales; Loi n° 2008-518 du 3 juin 2008*), unofficial English version 34 *Journal of Space Law* (2008) 453: “any activity consisting (. . .) of ensuring the commanding of a space object during its journey in outer space” is subject to an authorization requirement.