



Centring Environmentalism in Space Governance: Interrogating Dominance and Authority Through a Critical Legal Geography of Outer Space

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ARTICLE INFO

Article history:

Received 18 August 2021
 Received in revised form
 20 September 2022
 Accepted 25 September 2022
 Available online 2 November 2022

Keywords:

Legal geography
 Space law
 Critical geography
 Environmentalism
 Megaconstellations

ABSTRACT

This article brings into conversation scholarship in law and the social studies of outer space around the question of the “uses” of outer space, the shortcomings of existing legal instruments, and the possibility to reform them to place environmental concerns at their core. Starting from the Outer Space Treaty (OST), and using legal geography and an environmental lens, we highlight the interconnections between de-territorializing outer space, the image of the province of (hu)mankind, and the seemingly consequent egalitarian principle of benefit sharing. By reading this language of the OST against its historical context, we note that these seemingly egalitarian clauses mask the persisting hegemony of older space powers in access to and benefits from outer space. In this context, environmental protection clauses originally proposed by Japan, which were marginalized in the drafting of the OST, remain marginal to many governance mechanisms. Even when we decentre the OST and look at multiple legal and governance frameworks of outer space, from Planetary Protection to the International Telecommunications Union, these different approaches reiterate a utilitarian view of space environments that ties them to their usefulness to exploration and exploitation. These mechanisms, while useful for de-homogenizing outer space, do not go far enough in proposing that environmental protection underpins all principles of space governance. One of the effects of this failure is that more technically able nations keep crowding the orbits with megaconstellations. We propose an interdisciplinary approach to understanding the complex interrelation between space governance, geopolitics, and concerns about the future of outer space environments. A critical legal geography of outer space provides us with a possibility to examine the role of the law in relation to both geographical imaginaries and historical contexts and advance discussions on the role and responsibilities of humans beyond the planet we inhabit.

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1. Introduction

Interest in outer space environments is increasing due to New Space discourses surrounding an “exit strategy” amidst terrestrial scarcity and the developing climate catastrophe [1]. Arguments in support of human space settlements are popularizing a multi-planetary imagination [2] that sees infinite economic growth as a possibility only attainable when the universe, rather than the planet, becomes the horizon for human civilization. This view, troubling to many because it reposes a human exceptionalism which inherits historically and culturally instituted hierarchies of

gender, class and racialization, fails to acknowledge the anthropogenic nature of the climate catastrophe on our planet. Among the polluting activities beyond the earthly atmosphere, the proliferation of space debris poses a pressing challenge for “orbital-planetary environments” [3].

In the context of rising concerns about outer space environments, the spirit and the ethos of the Outer Space Treaty (OST) [4] are regularly referred to as principles guiding towards fairness in sharing the benefits of space assets [5]. However, discussions on place-making practices that reconfigure outer space environments as interrelated with earthly concerns rarely delve into the intricate history of negotiating space treaties or on the challenges of interpreting and implementing space law. This article brings into conversation scholarship in law and the social studies of outer space around the question of the “uses” of outer space, the shortcomings

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of existing legal instruments, and the possibility to reform them to place environmental concerns at their core. Referring to mega-constellations as a case in point, this article argues that a critical legal geography approach to space governance forces us to endorse environmental concerns in politically aware discussions about the uses of space. Underpinning this proposition is an understanding of space environmentalism as “care” for the protection of both space and earthly environments from a wide range of issues, such as: the cluttering of orbits, the dangers of debris reentry, biological contamination, and the impact of space-based infrastructures on celestial bodies. These issues call for looking at legal and socio-political constructions of outer space environments as entangled forces, which produce new hegemonies and can reinforce some actors’ authority when acting in space (as expanded on in the final section through a discussion of the concept of “environmental authority”).

Outer space, despite its legal characterization as “not territory” [6] by virtue of Article II of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST) [4],¹ is nevertheless a politically and socially constructed space. A legal geography approach to outer space highlights two points: (1) that deterritorialising outer space – as in the OST – is compatible with/and even synonymous with the possibility of exploiting space environments; and (2) that a homogenous approach to outer space (as in the OST) is not the only way in which governance is exercised. In fact, different legal instruments apply to “zones” of outer space: for example, low Earth orbit (LEO)² already has a distinct, though not separate, regime from the geostationary orbit (GEO)³; outer space and “celestial bodies” have differing degrees of permissibility of military uses, as well as levels of “planetary protection.” In this light, we look at how the available legal repertoire complexifies common representations of space as one homogeneous territory and propose a new characterization of archipelagos, techno-networks, and bio-cartographies. We then ask if and how the legal instruments available further environmental protection. Finally, we suggest that to centre environmentalism in space governance, we may need to decentre the OST and resurface some of the clauses that were marginalized by its history. After registering a move in current scholarship from geopolitics to environmental geopolitics and environmentalism in outer space, we propose to use the concept of “Environmental Authority” [7] to discuss how current claims of acting on behalf of humanity must be placed within the context of current hegemonies within space activities.

¹ Which is to say that States are prohibited from exercising control, jurisdiction or sovereignty on a territorial basis; the exercise of such sovereign functions is tied to national or legal persons and their space objects as per Article VI and VIII of the Outer Space Treaty (So the Perseverance rover is subject to US jurisdiction and control because it is a US space object, however this does not give the US any sovereign or territorial rights over that portion of Mars – any claimed ‘area based’ rights must derive from the space object, i.e. non-interference with ongoing activities, rather than being linked to the area itself).

² Low Earth Orbit is generally considered to be a region from 80 km to 2000 km, Geostationary Earth Orbit (GEO) is 35,786 km. There is a Medium Earth Orbit between 2000 km and 35,000 km however for our purposes as the distinguishing feature between LEO/MEO and GEO is that the unique feature of GEO is that objects in GEO are ‘synchronous’ with Earth meaning they are effectively ‘parked’ above a spot-on Earth’s surface, as this only work in the specific orbit it makes these ‘parking spaces’ unique, we will simply distinguish between LEO and GEO.

³ This is through International Telecommunications Union (ITU) regulation and driven by the ‘unique characteristics’ of Geostationary orbit. Lower orbits are more ‘crowded’ but less organized.

2. What are the benefits of deterritorializing outer space?

The OST [4] is the foundational treaty of the space law regime. It entered into force in 1967 and was negotiated via the UN Committee on the Peaceful Uses of Outer Space, which was established in 1959. While the treaty was the product of a multilateral negotiation process, the records of the negotiation make it clear that the United States and the Soviet Union dominated proceedings [8, p. 111, 120]. It is also generally recognized that much of the substance of the OST was commonly accepted; for example, key aspects such as the non-appropriation principle were already widely considered customary international law by the time of the treaty’s negotiation [8, p. 116].

In its Article II, the OST “rejects” the state based territorial order and forms the basis of a view of outer space that frames it as a “unique” legal domain operating outside of the normal realm of the international order. This framing has fuelled utopian readings of the treaty, which emphasize the egalitarian stances of the OST. On the surface, this is a reasonable reading of the treaty. The OST prohibits territorial claims [4, Article III]; prohibits nuclear weapons and other weapons of mass destruction as well as the establishment of military facilities or the conduct of military operations on the Moon or other celestial bodies [4, Article IV]. It emphasizes peaceful cooperation and equality of access and use of outer space as well as declaring that any use “shall be carried out for the benefit and in the interests of all countries” [4, Article I]. However, the negotiating history and the subsequent implementation of the OST reveal the heavy shadow of power politics on its language and operations – a shadow that extends upon our times.

In the context of the Cold War, US president Johnson viewed the treaty primarily as an arms control agreement [9]. However, Article II of the OST can also be read as a rejection of imperial territorial ambitions; this was in part about diffusing the “space race” by ensuring it remained symbolic.⁴ This geopolitical context matters because while, as Moltz argues, the environmental constraints of outer space shaped (but did not render inevitable) the development of cooperative initiatives such as the Apollo-Soyuz programme or the space governance regime. For Moltz, the recognition that military competition would undermine the utility of orbital environments for civilian and military purposes motivated this cooperative turn (although it could not have happened without the political will) [10, p. 45–56]. However, the lack of specific environmental provisions failed to prevent environmental hazards, such as the proliferation of space debris. This was partly due to the fact that the OST left the authority over implementing its articles to the subscribing states, creating a “unique” legal domain that nevertheless operates within the existing constraints of law and geopolitical configurations.

Already in 2003, Elhefnawy suggested that, much due to its ambiguities and the analogy with maritime law, the “space regime is inadequate to prevent territorialization, reflecting assumptions about the differential distribution of power, state interest and arms

⁴ Although, arguments that this was a ‘hedge’ against ‘losing’ the space race [11] fail to take into account that the standard of international law is effective occupation in order to secure a claim [12] which would have required a lunar presence substantially beyond Apollo and thus unachievable for either superpower. The realization of the effort and expense required to realize ‘effective occupation’ is what, in part, motivated UK support for the Antarctic Treaty [13] and rendered the ‘sacrifice’ of the US and the USSR in not laying claim to the Antarctic or the Moon less meaningful. Similarly, the ‘anti-colonial’ nature of Article II OST needs to be viewed in the broader Cold War context, as part of effort by the US and the Soviet Union to position themselves in relation to the waves of decolonization and appeal to newly independent states.

control” [14, p. 62].⁵ Concerns about hegemonic power and differential access to space resulting in *de facto* territorializations have recently resurfaced. *Spurring Private Aerospace Competitiveness and Entrepreneurship (SPACE) Act* [15], passed by the US Congress in 2015, supported rights of US companies to exploit minerals, water, and other space resources on a “first-come, first-serve” basis. Building on this, the Hague International Space Resources Governance Working Group promoted the concepts of “priority rights” and safety zones [16]. These were later advanced by the United States’ Artemis Accords [17], which has laid the conceptual groundwork for a territorialization of celestial bodies, in a manner consistent with the letter of Article II OST.

Looking at the geopolitical aspects that underpinned the drafting of the OST, its enunciation of space activities as being in the “interests of all states” and the figurative construction of a “province of all (hu)mankind” (provisions of Article I OST) emerge in their fundamental ambiguities. While the foregrounding of peace in outer space was laudable, the Treaty marginalized other issues: in particular, calls from the Japanese delegation for stronger environmental protection in what became Article IX were rejected by both the US and the Soviet Union [8, p. 61, 112, 123]. The initial proposal made by Japan at UN Committee on the Peaceful Uses of Outer Space in July 1966 was to expand and raise the “harmful contamination” provision initially proposed by the United States (what is now Article IX OST) to the standard of preserving the natural environment of celestial bodies “so far as possible in the condition it was in before the beginning of exploration.” To that end, Japan suggested that “the provisions designed to prevent the contamination of celestial bodies should be expanded and elaborated” [18]. Their reasoning for this position was based on concern that the scientific value of celestial bodies could be jeopardized by activities conducted without consideration of this potential “harm” [19]. In October 1966, Japan was still concerned that the proposed treaty provided inadequate protection for the natural environment of celestial bodies although US and Soviet opposition prevented any enhancement of protections [20]. Ostensibly the reason for the Soviet and American opposition was a concern that it would unnecessarily limit space activities. In this article, we suggest that environmentalism remains an underdiscussed or missing theme in current debates around space activities. The importance of environmental protection needs to be revisited for the OST to be upheld in its principles of equally using and sharing benefits from activities in outer space.

3. Uses and benefits

The OST focusses on activities in outer space rather than governance of outer space itself and has as a significant objective the facilitation of the use of outer space. It is the use of outer space which “shall be carried out for the benefit and in the interests of all countries.” Further, it is the use of outer space which is the “province of all (Hu)mankind,” not outer space itself. This contrasts with the Moon Agreement [21], in which the Moon and its resources are the Common Heritage of (Hu)mankind. Michael Laver’s predictions that “the spacefaring powers” would opt for a less structured regime to preserve their position seems rather prescient of the consequences of these differences [22]. Space governance does not completely reject the state based territorial order. While States cannot claim jurisdiction over outer space or celestial bodies themselves, they do maintain jurisdiction over space objects

⁵ Elhefnawy argues that the OST does not cover the risks of conventional weapons being placed in orbits or of possible attacks on satellites.

(whether they are small nanosatellites or inhabited structures such as the International Space Station) and all non-governmental activities must be authorized, and continually supervised, by a State [4, Article VI]. State sovereignty is not prohibited in outer space, and the OST simply means that the use of outer space does not grant any sovereign rights over that territory.

In brief, an initial plain reading of the text of Article I of the OST produces an impression of a relatively egalitarian and utopian aspiration; but the broader context demonstrates that states do not generally adhere to these ideals in practice. Often phrases such as “in the interest of all humankind” have been co-opted to cover activities that are state-centric, and/or in the specific interest of commercial actors. As demonstrated by the current cases of the creation of megaconstellations, or the NASA-sponsored commercialization of lunar soil,⁶ there are reasons to doubt the ways in which these provisions can and do promote egalitarian access and use of outer space.

However, there have been attempts to reinforce the aspiration that the use of outer space benefits broader humanity. The most significant effort was the “Space Benefits Declaration” [23] promulgated in 1996 (although the notion was first raised in 1988).⁷ This initiative was spearheaded by states of the Global South and can be seen as the end of the push for a more concrete expression of the principle that space is meant to be for the benefit of all humans [24, p. 32]. The statement that the use of outer space is meant to benefit all countries in the OST is, in practice, working as a reminder of the disparity between the utopian readings of the OST and the reality of state conduct.⁸ Given these asymmetries in space use, actors with more space capabilities need to balance the potential of outer space activities with concerns about outer space environments and their future. The growing pollution of orbits, exacerbated by megaconstellations discussed in Section 4, demonstrates that the construction of the use of space as a province of (hu)mankind has not supported the equitable sharing of space benefits. Instead, it has advantaged already powerful space actors without enforcing an appropriate show of responsibility towards the environmental cost of their activities.

4. Megaconstellations as a case study

The rise of megaconstellations exemplifies how states may not adequately consider whether the use of space they are authorizing is “in the interest” of all countries and humankind. Megaconstellations represent both an environmental and geopolitical concern and are significantly linked with the strengthening of national authorities. Talking about communication satellites, Parks and Schwach have suggested that the sky has been carved out into territories in ways that “are reminiscent of political leaders during the Treaty of Westphalia” [25, p. 4]. This form of *de facto* territorialization is exacerbated by the size of megaconstellations, which present specific environmental issues: from the crowding of orbits to their light pollution. Megaconstellations are primarily located in

⁶ Justin Harper ‘NASA to Pay Company \$1 to Collect Rocks from the Moon’ BBC News 4 December 2020, Available at: <https://www.bbc.co.uk/news/business-55170788>.

⁷ It is also relevant to note that negotiations were carried out during the collapse of the Warsaw Pact and the Soviet Union.

⁸ It does strengthen the ‘in the interest of all countries’ provisions and by referring to (hu)mankind it can be argued that it broadens it to “all peoples” and not just “all countries”, one could conceivably even argue an element of intergenerational equity in that.

LEO, which has a looser governance regime than GEO.⁹ LEO is also “more crowded” and has a higher density of existing debris.

Megaconstellations multiply anthropogenic objects in space, thus increasing the risks of collisions, damage to other objects, and reentry [26]. In discussing space debris, Rand's *Falling Cosmos* highlights that contamination and “reentry” are not new or extremely remote threats [27]. “Nuclear reentry” – i.e. the fall of parts of satellites that were nuclear-powered – is part of earthly environmental history. In 1978, the Soviet satellite Kosmos 954 crashed in the Canadian Arctic ignited global anxieties about human and environmental contamination due to particles of radioactive material. The crash exposed local Indigenous communities to the risks of space activities that brought them no benefits, while international governance could guarantee no adequate protection or compensation.

Megaconstellations raise these threats. Also, like communications satellites in general, they have a geopolitical aspect. Space objects are more than technology; they are embedded in a social and political context, including international power structures [28, p. 73–75]. The fact that their ownership is increasingly concentrated in the hands of a few global players, with Starlink currently owning more than a third of the total satellites in orbit, highlights this reality. Their value as “infrastructure” additionally makes them national assets whether they are developed by the government or private sector. China is developing a “national” satellite network,¹⁰ and it is not by chance that Starlink has the US military as a significant customer.¹¹ The UK's investment in OneWeb was heralded as an investment in a “sovereign” space capability.¹² So, when environmental concerns about megaconstellations are raised, particularly given the number of proposed satellites and the related debris generation, these concerns are often dismissed on the basis of new geopolitical imperatives: for example, Western countries refer to the rise of Chinese space power and their perceived lack of adherence to international protocols as warranting defence and investment in new infrastructure.¹³

Megaconstellations stand out as a case in point to look at the benefits of a critical legal geography approach: the issues they present are to be “located” in the relevant intersecting governance regimes, and their proliferation highlights how “terrestrial” geopolitics, and the failure of the OST to genuinely promote equitability in access and benefits, trumps environmental issues. As both orbital shells and radio frequencies are assigned on a “first-come, first-serve basis,” this “space rush” is rewarding the world's most powerful spacefaring nations and a small number of their private firms. However, the multiple risks they pose, including issues of access and use by emerging powers and contamination due to rocket launches call for renewed attention [26]. There are also

⁹ The ITU grants specific orbital ‘slots’ for Geostationary orbit, whereas the location of a space object is less regulated the focus is on avoiding interference with communication signals.

¹⁰ Andrew Jones, China is Developing Plans for a 13,000 Satellite Megaconstellation, SpaceNews, 21 April 2021, Available At: <https://spacenews.com/china-is-developing-plans-for-a-13000-satellite-communications-mega-constellation/>.

¹¹ Mark Harris, SpaceX's Starlink Satellites Could Make US Army Navigation Hard to Jam, Technology Review, 28 September 2020, Available at: <https://www.technologyreview.com/2020/09/28/1008972/us-army-spacex-musk-starlink-satellites-gps-unjammable-navigation/>.

¹² Department for Business, Energy and Industrial Strategy, Press Release: UK Government to Acquire Cutting-Edge Satellite Network, 3 July 2020, Available at: <https://www.gov.uk/government/news/uk-government-to-acquire-cutting-edge-satellite-network>.

¹³ C.G. Starling, M.J. Massa, C.P. Mulder, and J.T. Siegel, The Future of Security in Space: A Thirty-Year US Strategy, Atlantic Council, April 2021. Available at: <https://www.atlanticcouncil.org/wpcontent/uploads/2021/04/TheFutureofSecurityinSpace.pdf>.

fears that megaconstellations will alter significantly the views of the night sky [29], which would impact disproportionately Indigenous communities with ancestral social and cultural ties with the sky [30].

As Clormann and Klimburg-Witjes summarize, the current challenge of anthropogenic waste in orbit is one that follows the increased activities in outer space and calls for new understandings of where responsibility – both in legal and ethical terms – lies: “Space debris and its increasing presence due to New Space endeavours seems to bring a novel sense of urgency to these debates” [3, p. 20]. If, as Klinger reminds us, “territorial questions are always also environmental questions” [5, p. 23], contemporary geopolitical discussions about control and use of satellites must include questions about environmental responsibility, for example for the clean-up of orbital debris. A handful of nations disproportionately occupy space by virtue of their longer histories of space activities and technological capabilities, and megaconstellations accelerate the need for these actors to deal with environmental pollution.¹⁴ In the next section, we look at how a legal geography approach – which takes seriously the legal construction of different outer space environments – is key to appreciate the inadequacy of existing legal regimes to deal with the challenges of current space activities.

5. OST decentred: multiple legal geographies

The OST is the prominent and most widely supported mechanism of legal governance, but it is far from the only one. While its core principles apply uniformly across outer space, the Moon and other celestial bodies, space law, and governance have developed a more complex imagination of outer space. In looking at the legal forms of spatialization, we take up Dunnett's invitation to rethink “specific geographical terminologies and how they might apply to studies of outer space” [32, p. 315]. In this section, we propose alternative taxonomies emerging from the law of outer space and reflect on the cartographies of power these legal frameworks present.

We refer here to lessons from legal geography, a fusion of human geography and legal scholarship that emerged in the 1990s.¹⁵ Legal geography recognizes the interconnections between law and space and how they construct one another. Legal spaces are constituted in the interaction between physical and contextual elements; the scale of spaces examined varies and can involve consideration of the temporal element (i.e. how specific legal regimes can apply at specific times and in specific spaces) as well as the physically bounded space. Legal geographies can keep a tight focus on the interplay between politics, economics, and environmental aspects of law-making. The environmental issues posed by megaconstellations make it clear that their existence, justification, and use for specific benefits are politically situated issues.

We argue that paying attention to legal geographies can have the welcome effect of challenging what Riles [33] has described as a “globalizing gaze” of international law. The “globalizing gaze” “elevates” local issues to a “higher” international plane of concern, shifting them from local (particularly indigenous) hands to the concerns of international bureaucrats, officials, and lawyers in the capitals of the international order (London, Geneva, New York, and Washington). This “globalizing gaze” can obfuscate or neutralize

¹⁴ Although the danger of regime fragmentation argues against a polycentric approach, particularly given the environmental realities of the orbital environment, as argued for by Morin and Richard [31]. While polycentric approaches do allow for experimentation which does have merit, the nature of international law works against such complexity.

¹⁵ See: N. Blomley, D. Delaney and R.T. Ford (Eds.), *The Legal Geographies Reader*, Blackwell, Oxford, 2001.

representations of local and geopolitical inequalities. It also allows states to reframe national and political activities as “neutral” activities which benefits “everyone.”

Newman, Blount, and Steer have given consideration to geographical aspects of space law; however, this remains an underexamined aspect of space law scholarship. Newman has argued that the Moon should be regarded separately from the “other celestial bodies” given its cultural connotations and visibility from Earth [34]. Blount recognizes space law as part of the European tradition of incorporating “new areas” into the established “spatial order” of international law [6]. Steer argues for a changing understanding of the language of the treaties in order to reflect modern realities [35], as well as situating them within the geopolitical order and the North/South power paradigm [36]. These valuable insights can be further enhanced by a fuller embrace of critical legal geography as a methodology.

Having highlighted the ways in which geopolitical power-plays have marginalized environmental claims in the writing of the OST, a legal geography of outer space can help us see how existing legal regimes are necessary but not sufficient to regulate or enforce principles of environmental protection, equity, and sustainability in access to and use of outer space. By analysing how the law presents outer space geographies, the images that surface are key to understand the limits of the patchy provisions of the law. In the following taxonomy of geographical images emerging via legal and governance provisions, we highlight how they enable and/or constrain discussions on the possible uses, conservation, and preservation of outer space environments.

5.1. Archipelagos

Space law can be seen to extend to objects in outer space through the creation of “islands of sovereignty,” which remake state territories into archipelagos beyond the thin line of our atmosphere.⁶ Borrowing from Benton’s description of ships as “islands of sovereignty” on the high seas [37, p. 112], a similar conception works for space objects in outer space. Ships are “islands of sovereignty” because states have “exclusive jurisdiction” over ships which fly their flags on the high seas (UNCLOS, Art. 92) [38] and they are required to exercise “jurisdiction and control” over those ships (UNCLOS, Art. 94) [38]. This is directly analogous to the provisions in Article VIII of the OST, which stipulates that the state of registry retains jurisdiction and control over any space object and its personnel. It is further enhanced by the requirement that states authorize and supervise the activities of their nationals in outer space (OST, Article VI) [4]. Jurisdiction and state authority in outer space, like on the high seas, are exercised over persons and objects not territory. Nevertheless, this is a thrusting of state power into an arena that is generally considered “beyond national jurisdiction.” Concepts such as “safety zones” that are being advanced as part of proposed regimes for surface activities [16,17] will only enhance this aspect. This approach is focussed on human made objects. There is a minimal concern for the impact of these objects on the space environment, and liability arises from damage to other space objects or terrestrial concerns (Article VII OST) [4].

An environmental approach recognizes that the while the jurisdictional issues are important, having “due regard” for the interests of other states and their nationals requires considering the impact of proposed activities on the environment. While individual space objects may be “islands of sovereignty,” megaconstellations

are “archipelagos of sovereignty” occupying considerable swathes of the space commons and highlight the lack of concern this approach engenders. Under the technocratic rules of space governance, there is no issue with Starlink’s 42,000 proposed satellites.¹⁶ However, the impact of tens of thousands of satellites on the space environment and the use of Earth orbit by other actors, to say nothing of the impact of the launches necessary to place them in orbit, needs to be considered. When exercising sovereignty over these objects, actors can *de facto* curtail other actors and emerging space powers’ access to space. This privileged position is not met with equal imposition of responsibility over space environments. Promises for satellite deorbiting after an agreed timeframe do not address the risks of moving objects across increasingly congested orbits. Looking at megaconstellations as archipelagos shows another failure of space governance, as sovereignty over increasingly large parts of space by virtue of ownership of megaconstellations requires limited commitment to remedial actions and environmental protection.

5.2. Techno-networks

The International Telecommunications Union (ITU), a specialized agency of the UN, broadly upholds a tripartite division between LEO, GEO, and the “rest of space” and looks at the governance of satellites in two distinct regions: LEO and GEO. The ITU serves as the forum for the international governance of the radiofrequency spectrum, which is necessary for communication with satellites. In low and medium orbit, space objects are allocated a “band” of this spectrum for communications, but these satellites are not allocated a specific orbit to inhabit. However, because of the “unique” nature of GEO, satellites due to operate in GEO are granted an orbital “slot” along with a frequency allocation. These slots are allocated on a “first-come, first-served” basis and can be effectively occupied by the recipient indefinitely. While LEO is less “regulated” spatially, there are bands or areas of orbit which are more “useful” and therefore have wound up being more crowded. While on the surface, allocation of spectrum and GEO slots is a technocratic process governed by a highly technical, specialized agency (and therefore supposedly apolitical or neutral), political, geographical, and environmental issues remain. As Collis suggests, the ITU has been unable to deal with conflicts arising from illegitimate claims and occupation of slots, as in the case of the fight for space between Japan, Tonga, and Vietnam in the 1990s. It is also ineffective at distributing orbital space equally because assigned slots must be occupied within a specific timeframe and emerging space countries may not have the capability to do so [39]. As a consequence, the US and Europe own most geostationary satellites, and the “useful” lower orbits are increasingly “filling up” with active and inactive objects (debris).

This problem is being exacerbated by the development of megaconstellations, which are “mega” largely to replicate the coverage potentials of much smaller geostationary constellations (higher orbits mean a single satellite can cover a wider area of the Earth but it means that signals take longer) without the signal delay and as a way of avoiding the “congestion” of GEO. However, the proliferation of thousands, potentially tens of thousands of satellites will generate considerable issues for the lower orbital regions. Megaconstellations clearly demonstrate why the regulation of the use of Earth orbits needs to account for the physical use of space as well as the radiofrequency spectrum being utilized. While thinking of technological networks is useful to highlight the ways in which “clumps of satellites” make up a material extension of territorial domains and point to the responsibility of specific actors in relation to the cluttering of outer space, the ITU’s purely technological remit

¹⁶ Caleb Henry, SpaceX Submits Paperwork for 30,000 more Starlink Satellites, SpaceNews, 15 October 2019, Available at: <https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/>.

ends up obfuscating broader geopolitical and environmental concerns.

5.3. Bio-cartographies

Planetary protection creates a geography of outer space that differentiates between useful natural objects¹⁷ and useless natural objects¹⁸ in relation to the search for life. This utilitarian approach devalues some celestial bodies and can “hide” the commercial interest around them: asteroids for example may be “not useful” for astrobiology but are “useful” for space miners due to the resources contained. Similarly, the Moon is not as valued as Mars for those seeking to “understand the process of chemical evolution or the origin of life” [40], but it is valued for its resources and proximity to Earth. The Moon also has significant cultural and spiritual value for many communities, although the space governance regime does not adequately consider this aspect with regards to potential uses. It is necessary to reconsider valuing objects as “useful.” For one, there can be a tendency to conflate use and purpose and that can prejudice conceptions of value. It is also important to note that stewardship requires restriction of use, recognizing the future users as stakeholders and accepting that the use in question will change.

While planetary protection applies to space environments thought to be/have been potentially harbouring life, its binary around “usefulness” conceals the complex interrelation between different space environments and the objects that inhabit them. Legal zoning is only helpful if principles of environmental protection underpin all governance mechanisms. For example, while megaconstellations seem to be of no significance when considering deep space exploration, and planetary protection principles do not apply to human-made space objects in Earth orbit, it is important to note that the increase in space debris resulting from new space activities and megaconstellations can and most likely will create a challenge for the exploration of farther space environments: a cluttered orbit is an obstacle to future life detection missions.

When thinking about how notions of “usefulness” of outer space environments underpin many of the legal instruments that regulate both human activities and anthropogenic objects, we should be asking more questions. Not only for whom are space activities/objects/environments useful? Or “in whose interest” are claims to outer space made? But also, how are these mutually supporting geographical categories and legal domains re-territorializing outer space and who benefits? While helpful in challenging the imagination of outer space as a homogeneous territory, these multiple regimes appear to be technical in remit and utilitarian in scope. They do not go far enough in ensuring the protection of space environments for the creation of sustainable futures.

6. Between critical geography and environmental geopolitics

Legal instruments – as outlined in the previous section – appear to subsume environments under the possibility of them being “useful” to humanity on Earth. They have also been ineffective at challenging the cluttering of orbits by a narrow – though expanding – pool of space actors. This form of anthropocentrism, in the New Space age, has had the effect of reigniting discourses about occupying outer space. Cross has questioned the political construction of the space race but also highlighted that the

intensification in space activities can trigger new security dilemmas. This ties in with Moltz’s arguments that while the nature of the space environment played a role in shaping the governing order, the ebbs and flows of the Cold War, and political will to cooperate (or compete) played a larger role [41].

We have already highlighted the ways in which the creation of archipelagos of sovereignty via megaconstellations serve nationalist and commercial goals. Moreover, positing space environments as possible extraterrestrial abodes mirrors the extractive fantasies of accumulation of resources that were a driver of Western colonialism in the 1400s and punctuated modernity ever since. Smiles [42] and Trevino [43] detail how coloniality remains a fundamental logic of space expansionism, and the frontier narrative is a rendition of the deeply engrained fantasies of appropriation of land and resources that push the horizon of possibility always a little bit further. If modernity and coloniality are coterminous [44,45], modern space expansionism [7] extends human exceptionalism to create enclosures and practice extraction on other celestial bodies.

Against an understanding of space as existing “out there” to be used and colonized, the creation of several legal regimes demonstrates that zoning of outer space takes place dynamically and in response to the changing configurations of an era. This view builds upon a long tradition of geographical thought, including Gregory’s *Geographical Imaginations*, in which contextual understandings of space and territories must happen in the light of the always relational nature of context and place [46]. Massey’s work on space [47], which challenged static understandings of territories, posited space as an open and discontinuous social construction. Massey’s approach to geography strongly accounts for the ways in which space matters to understanding social, economic, political, and legal relations. If outer space is not merely accessed through scientific efforts but produced for human eyes to see, it becomes important to ask what existing representations are useful for (or to whom) and what are their limits. A relational understanding of outer space calls for an analysis of the structures of power that operate through its hegemonic representations.

To this end, scholars have looked at the influence of spatial imaginaries [48], technologies [49], and artistic representations [50] on understandings of outer space and traced the ways in which space plays an active part in national histories. Dunnett shows how, in the British context, nationalist and colonialist concerns have supplanted the early promise of space activities as an escape from the limits of the nation-state [51]. For Sage, the moon programmes during the 1960s were meant to rescue the United States’ dwindling global leadership and reaffirm messianic narratives about American exceptionalism [52]. NASA became a blueprint for the modern American enterprise bringing together technology, scientific and engineering expertise, big business, and government. More recently, Olson [48, p. 11] posited the space agency as a “producer of system–environment relationships at scale and in the extreme,” stressing how system-thinking allows for discussing Earth and space environments as cosmologically and politically interconnected.

This focus on the production of spatial knowledge within states and key institutions is in keeping with the analytical methods of critical geopolitics as conceptualized by O’ Tuathail [53, p. 61]. Looking at the interconnections between space and power, a range of geopolitical imaginaries emerge to form and shape what often appear as sedimented geopolitical traditional categories. Two recent works by Deudney [7] and Bowen [54] have supplemented existing engagement with geopolitics and geography in discussions of space power and governance, such as Moltz [10] and Peterson [11]. Additionally, they both take issue with the “separateness” of outer space, given the interconnections between activities on Earth and those in outer space. While agreeing with these criticisms, this

¹⁷ Based on a reading of the COSPAR Planetary Protection Policy [40] those celestial bodies (planets, moons, comets, asteroids etc) with a significant interest for understanding the process of chemical evolution or the origin of life.

¹⁸ As per COSPAR Panel on Planetary Protection [40] those not of direct interest for understanding the process of chemical evolution or the origin of life.

article complements these studies by adopting a legal geography approach that sees international law and the mechanisms of its development as a force in international governance. The geographical imaginations produced through legal knowledge about outer space shape our spatial consciousness of the colonial present. In highlighting their limitations, we aim to foreground “geographical imaginations that can enlarge and enhance our sense of the world and enable us to situate ourselves within it with care, concern” [55, p. 262].

However, attention to outer space environments remains limited. Writing about Aboriginal cosmological thought in Sky Country (Australia), Mitchell et al. maintain that the Western dominant spatial imaginary sees Earth as an enclosed globe, a “sealed vessel” disconnected from space, and this constitutes a significant barrier to a more just relationship with our place of dwelling [56]. Beery made the argument that “nature” should be a primary analytic for geographical approaches to outer space [57, p. 50–1]. Along these lines, Klinger [5] proposes to rethink the relation between earth beings and the cosmos as one of connectivity and dependency. Agrawal’s concept of “heliosystemic environmentality” [58], which places the sun as central to the sustenance of life on Earth, is a useful entry point to map the physical dependency made by “a long series of chemical reactions and flows of electromagnetic radiation” [5, p. 10]. Similarly, Olson and Messeri [59] suggest that thinking about outer space as an environment is a useful starting point to create, imagine and narrate the Earth through “dynamic meshworked [55] relations (human and otherwise) with other cosmic agents, materials, and forces” [60, p. 42].

In centring environmentalism in this conversation about the construction of outer space, the focus on environmental geopolitics has recognized the power asymmetries involved in its governance. For Beery, outer space and orbits “are not inherently ‘global’ natures; they were and have been made so through negotiations rife with structural and social power imbalances that favoured economically developed space-faring states” [61, p. 99]. These processes threaten to expropriate all but an extreme minority of a peaceful cosmos explored for the benefit of all humankind, as stipulated in the 1967 OST [4]. As “the environmental geopolitics of outer space are inseparable from questions of environmental justice” [5, p. 11], the issue of orbital debris exemplifies three points: (1) it is mostly old spacefaring nations with technical capabilities that are responsible for the current level of pollution; (2) the ways in which the shadow of the Cold War affects current space activities also materializes in the widespread disregard for environmental concerns; (3) understanding space as relational opens up discussions of planetary-scale environmental justice, upon which equitable access to space and sharing of space benefits depend.

7. A critical legal geography of outer space: environmentalism without authorities

Outer space geographies have been a useful entry-point to discuss concerns about access to and uses of these environments. As seen in the first section, the question of utilizing space as a “resource” is not simply settled through the egalitarian language of the OST. Several legal instruments, some very technical in language and specific in remit, such as planetary protection, have created outer space environments that are subordinated to human use and aspirations. The conditions, and the limits of acceptability of current “uses” of space are not independent from the power-plays at work in the “New Space” Age. Making use of a common analogy between Antarctica and outer space, which enjoy similar specialized legal regimes, Salazar affirms: “As critical legal geography scholars have pointed out, “law is not a neutral organizer of space, but is instead a powerful cultural technology of spatial production.”

Antarctica and outer space are here once again conflated as the exploration of mineral and biological resources becomes increasingly viable in the case of outer space, and ever more pressing in Antarctica.” [62, p. 402]. This quote intends to alert us on how activities such as bioprospecting in Antarctica, which is the scouting for new molecules that can be used in the pharmaceutical industry, have already presented us with the competing priorities of market exploitation and environmental preservation.

However, the situation of Antarctica, and the growing discourse around its significance as a testbed for outer space, also shows that governance regimes that privilege the creation of environmental knowledge of unique environments do not halt, and potentially support, resource exploitation. They have the effect of supporting the hegemony of certain actors, namely older spacefaring powers with the technical assets to produce knowledge about remote environments, over others. Howkins uses the concept of “Environmental Authority” [63], which bears similarities with the notion of scientific nationalism developed by Stroiikos [64], to cast Antarctica as an “imperial environment,” where the old imperial actors have quite literally used environmental knowledge over environments to reinforce their power over defining the terms of the use of those territories. The analogy with Antarctica is helpful here to point out that the debate over exploiting space was certainly not settled by the seemingly anti-imperialist and utopian language of the OST. However, the concept of “environmental authority” also narrates a shift away from traditional top-down space-power geopolitics towards other forms of hegemonic claims, for example, those made in the name of environmental protection.

In Howkins’ work [63], the creation of “environmental authority”¹⁹ takes place when the “production of useful scientific knowledge about an environment” supports and reinforces political control over that environment. In this view, notionally apolitical scientific activities are intertwined with political claims and objectives. Stroiikos helpfully questions the very idea that science and technology can be understood as divorced from their political context. Focussing on India and China, he notes that technological advancement is a social construction that creates “a civilisational standard that differentiated the ‘society of civilised states’ from non-European societies” [65], p.730]. Conservation measures are one manifestation of this form of hegemony, or environmental authority: scientific activities and the knowledge produced render particular actors best placed to protect the environment in question [63, p. 8]. Environmental authority can also manifest in claims that science is being conducted “in the interests of all humanity” [63, p. 167]. Looking specifically at the Antarctic Treaty, Howkins argues that, rather than “decolonizing” Antarctica, the Treaty has embedded imperial interests in the system and advanced a “collective assertion of environmental authority ...” [63, p. 131], which can be seen as an “enclosure” of the Antarctic commons. This is particularly evident given the explicit link between conducting scientific activities in Antarctica and eligibility for Consultative status within the Antarctic treaty system [66, Article IX, para 2].²⁰

Environmental authority is a useful way of understanding the space paradigm and its relevance comes to the fore more clearly when a critical legal approach is combined with an interest on the geographies of outer space. Science is presented as the predominant reason for expenditure in outer space, the “benefits for all

¹⁹ Howkins has developed the concept but the phrase was first used by Klaus Dodds in *The Antarctic: A Very Short Introduction*, Oxford University Press, Oxford, 2012, 92.

²⁰ The emergence of an environmental authority can be seen in other environments too: for example, the establishment by the UK of the Chagos Island Marine Reserve, touted as the largest in the world, is part of the effort to secure the UK’s disputed claim of sovereignty over the islands.

humanity” that flow from that are supposed to justify the political dominance of the “space actors.” While the OST does not privilege the users of outer space, the shift towards customary and soft law, and “multistakeholder” approaches does, in practice, privilege the users of space, particularly as they are framed as having a better understanding of the “realities” involved and are therefore best placed to provide insight. A multi-stakeholder approach needs to embrace all stakeholders and not privilege the “users” of an environment or resource; the “environmental authority” of mega-constellations operators must not be allowed to exclude alternative voices.

Environmental authority provides an insightful prism to view the use and user centric Artemis Accords [17].²¹ The Artemis Accords, given the connection to the US Artemis programme, can be seen as a “users” club (which in many ways has parallels to the Antarctic Treaty) and highlights how the dominance of a group of “like-minded states,”²² led by the United States, is driving the interpretation and development of space governance, specifically for the use of the Moon and its resources. Despite claims of being international and “for humanity,” these “accords” must be seen in the light of new geopolitical confrontation, especially now that Russia and China are working on an alternative to the Artemis Accords.²³ While the “strategic” implications of a so-called “new space race” are overblown, they nevertheless feature heavily in Western discourse,²⁴ and while scientific goals are part of these programmes they are nevertheless subordinated to political and economic objectives.

The question of envisaging equitable access, use and distribution of the expected benefits of space for (hu)mankind, introduced in the previous section via Klinger's focus on environmental geopolitics and reworked here through a focus on environmental authorities, is crucial to refuse an acritical reproduction of North–South divides and a widening of the gap between space-faring and non-spacefaring nations. In the face of the historical marginalization of explicit environmental clauses in space law, our work has attempted to advocate for a critical legal approach to space law that foregrounds environmental concerns but also recognizes that environmentalism is a discourse that Western powers have used to strengthen their claims to territorial access and exploitation.

8. Conclusion

Adequate governance and protection of outer space environments is fundamental to the building of more sustainable futures. The increase in outer space activities and megaconstellations points towards the importance of developing modes of environmental protection beyond Earth that do not end up reinforcing the hegemony of old space powers. Our argument is that a critical legal geography of outer space must account for cultural, economic and political elements that influence the ways in which outer space environments (and their diversity) are experienced, conceptualized and accessed. As a first step towards outlining the promises of this

approach, we highlight that more work is needed, and that geographers, ecologists, lawyers and others need to work together to propose new imaginaries and modes of living in/with outer space. After considering the legal scholarship on geopolitics on the shaping of the law, we have looked at the emergence of interdisciplinary conversations connecting environmental concerns on earth and outer space. This literature has not yet been related to space law.

One thing becomes clear when using this approach: space governance needs to explicitly deal with environmental concerns before exploitation of outer space begins in earnest. While “on paper” the OST sets a utopian vision for the use of outer space, in practice this use-focussed regime, with interpretation and implementation left to individual states, has not provided adequate protection for the orbital environments. The history of the OST reveals that a more environmentally conscious space law regime was considered and, as discussed, the Japanese delegation pushed for a more robust version of what is now Article IX OST. This approach was rejected in favour of the more “pro-use” approach in the OST, which heavily advantaged the interests of strong space-faring powers. The popularity of the OST is to be contrasted with the more environmentally focussed Moon Agreement, which is generally regarded as a failed treaty and lacks support from national governments. The Moon Agreement, instead, represents a possible environmentally sensitive regime (specifically in Article VII); however, given the lack of development of the Moon Agreement since 1984 we suggest that rather than attempting to revive it, space governance needs to centre environmental protection in all future governance instruments.²⁵

In brief, it is possible and advisable to develop new instruments for environmental protection that build on the existing infrastructure of space governance. Future space governance should uphold and value the commons as a multi-stakeholder (meaning all stakeholders not just industry or powerful states) arena beyond national jurisdictions. This includes recognizing that the use of outer space, by the mandate of Article I OST, must be carried out so as to be in the interests and for the benefit of all countries, and that such use is the province of all (hu)mankind. In the implementation of a multistakeholder approach, care needs to be taken to ensure that “environmental authority” does not become a mechanism for dominance by early or powerful actors as this will embed existing power dynamics.

Concern about the space environment is not new, but there is a growing necessity to implement the provisions of environmental protection. Earth orbit is already experiencing the consequences of inadequate protection and these harms risk following increased human activities throughout the solar system. Therefore, future space governance needs to adopt the spirit of the Moon Agreement's environmentalism and “take measures to prevent the destruction of the existing balance of the [space] environment.” (Article 7) while recognizing the limitations of that specific instrument (as well as the geopolitical context of the treaty). A critical legal geography centred on environmentalism will be invaluable in doing that.

Funding

AstrobiologyOU has received funding from Research England (Expanding Excellence in England).

²¹ The Artemis Accords promoted by the United States and joined by 21 countries (as of July 2022), attempt to develop and advance specific aspects of space governance to facilitate the use of the Moon and its resources. Despite the name they are not a treaty, but a ‘soft law’ instrument tied to the US Artemis programme.

²² A phrase particularly in vogue during the Trump presidency.

²³ Joey Roulette, China, Russia Aim for First Joint Astronaut Moon Landings in Next Decade, *The Verge*, 16 June 2021, Available at: <https://www.theverge.com/2021/6/16/22536625/china-russia-nasa-joint-astronaut-moon-landing>.

²⁴ See for example, Namrata Goswami, The Strategic Implications of the China-Russia Lunar Base Cooperation Agreement, *The Diplomat*, 19 March 2021, Available at: <https://thediplomat.com/2021/03/the-strategic-implications-of-the-china-russia-lunar-base-cooperation-agreement/>.

²⁵ While the Guidelines for the Long-term Sustainability of Outer Space Activities (UN Doc A/AC.105/2018/CRP.20) are a positive development, as is the pattern with space governance they centre the use and usability of outer space, are reactive to the space debris crisis, and importantly are non-binding.

Author statement

Both authors have provided equal contribution to the conception, preparation and writing of this article.

Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data availability

No data was used for the research described in the article.

Acknowledgements

The authors wish to thank Shonil Bhagwat, Lauren Napier, Christopher Newman and our anonymous reviewers for feedback on earlier drafts of this article.

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