Outer Space Imaginaries: Deconstructing the Privatization-Securitization Nexus

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Abstract:

Outer space is increasingly the site of political tensions. At the same time, the growing role played by private actors in space creates opportunities and challenges for defence and security. This article aims to unravel how outer space imaginaries influence the practice and decisions regarding outer space (security) governance. Adopting a deconstructive approach informed by critical geopolitics, it identifies dominant and competing discourses about outer space that are underpinned by material and ideational factors. We demonstrate how, in combination, these discourses have shaped practices by various actors of the space community and normalized a highly technical approach to challenges, solutions and governance, contributing to a "privatization-securitization nexus" in outer space.

Keywords:

Outer space; discourses; privatization; securitization; geopolitics; anti-politics; representation

Introduction

The evolution of technology and the changing nature of war and warfare have constantly been intertwined (van Creveld, 1989)[1]. Such a connection has been particularly prominent in outer space: the 'space race', nuclear deterrence strategies and Cold War international politics cannot be dissociated (Bowen, 2022). The 2026 Artemis II mission (led by NASA) shows that space exploration is still intimately linked to power and prestige; in this case, who will first be able to establish a permanent human presence on the Moon. In the current era of global geopolitical tensions, outer space continues to be a crucial site for defence and security[2]. Whereas this key role is certainly not new, it is exacerbated in periods of geopolitical turmoil. In a volatile military context, outer space is of strategic importance for intelligence gathering, multi-domain awareness, communication, deterrence, and more. For example, in 2021, Russia destroyed one of its own satellites using an anti-satellite weapon (ASAT). This generated debris and created safety hazards for spacecrafts around the testing site and orbit (Gadsby, 2021). This should be put in parallel with Russia's grey zone tactics and current threats against Western critical infrastructures, including a recent statement that outer space "quasi-civilian infrastructure may become a legitimate target for retaliation" (Vorontsov, 2022).

At the same time, the past two decades has seen an unprecedented wave of private endeavours in space, from Virgin Galactic's suborbital tourist flights to SpaceX's contribution to established governmental programmes such as delivering cargo and, since 2020, people to the International Space Station. These corporations have brought civilians (and civilian interests) into space, whether for space tourism, scientific projects or potential resource exploitation and profit making. In doing so, they have also started to challenge the monopoly of states as the dominant outer space actors.

In the past 70 years, the body of international space law has increased to cover a wide variety of activities from weapons in space to geostationary orbit allocation, and from exploitation of extraterrestrial resources to the management of space debris. Space governance is multifaceted and encompasses commercial, military, environmental, ethical, and legal dimensions. Nevertheless, with the rapid development of new technologies, the increasing geopolitical tensions, and the growing role of private sector in space, decisions have to be made regarding outer space governance, sovereignty rights, property rights, as well as the role, rights and responsibilities of non-state actors. In particular, decisions are expected in the field of outer space security governance that is impacted by the increasing presence and power of private actors.

This article postulates that such decisions are constrained by dominant and competing discourses that represent and construct outer space in different ways. Authors in disciplines as varied as history, political science, human geography, and anthropology have critically discussed the way outer space representations are intrinsically linked to politics. For Popper and Rakotoniaina, "master narratives" that originated during the 1950s and 1960s Space Race "continue to shape popular outer space imaginaries - based on colonial rhetoric, exploration

[1] This article is based on an oral presentation at the 2023 British International Studies Association (BISA) Annual Conference, 23 June 2023.

[2] There is no agreed legal definition of outer space. The agreed consensus is that the upper limit of air space (which is under sovereign jurisdiction of states) is 100 kilometres above earth surface. In this article we include near space/suborbital space (50-120 kilometres) into the definition of outer space. See P.M. Dempsey (2017).

imperatives and belief in technological progress" (2019: 1). Geppert suggests that "changing conceptions of outer space […] must be read as historical expressions of earthly ideas of the spatialized beyond and past expectations of planetary futures" (2012: 14). MacDonald (2007), meanwhile, notes that the geographies of earth and space are no longer remote from one another and that space both informs our terrestrial geographies and has its own geography to contend with. Efforts to categorise these geographies have been undertaken by Dunnett et al. (2019), who also argue of the importance of individual voices in space, as opposed to current meta narratives. Indeed, dominant representations serve political purposes. Mendenhall criticises the widespread and enduring reliance of the main actors of the space community, that is governmental, industry and scientific actors directly involved in space activities, "on analogies with other international domains - the ocean, airspace, and Antarctica - to classify outer space" (2018: 98). She explains that "each analogy is used to argue in favor of a particular political, economic, or military action" (p.105). Similarly, Rahder stresses that the language employed is also important in that it has framed space exploration since the beginning: from space 'conquest' to the 'colonization' of Mars (2019: 160-61). And Sage (2008) shows that this also expands to traditional forms of arts such as material from NASA's own art programme that draws from the 'manifest destiny' period of US history within the Rocky Mountain School. Holland & Burns (2018) explore the narrative espoused by the US government throughout history to identify how the US' aims and circumstances in space have evolved as policy develops from Cold War competition to international cooperation. However, the idea of US leadership in space have never disappeared. This is also a thread followed by Maclaren (2021) through the review of space shuttle mission patches as solitary US flags begin to feature others in the post-Cold War era, albeit non-Western space discourses (e.g., Mitchell et al., 2020) remain underrepresented and subaltern reflecting in a Western-led academic literature on the construction of outer space.

In this discursive and academic context, this article contributes to existing debates about the construction of outer space by focusing on security governance and the role of the private sector. It aims to unravel how outer space imaginaries influence the practice and decisions regarding outer space (security) governance. Adopting a deconstructive approach informed by critical geopolitics, it identifies dominant and competing discourses about outer space that are underpinned by material and ideational factors. We demonstrate how, in combination, these discourses have shaped practices by various actors of the space community, normalized a highly technical approach to challenges, solutions and governance, eventually contributing to a "privatization-securitization nexus" and an anti-politics (Ferguson, 2006) and anti-geopolitics machine in outer space.

Deconstructing discourses on outer space

Our approach draws on critical geopolitics and assumes that the creation of knowledge (and the construction of 'truths'), or in other words, the power to define, normalizes practices and relationships of dominance (Ó Tuathail, 1996: 80; Germond, 2013: 80). This framework enables deconstructing discourses whose geographical/spatial and geo-power characteristics are central to the narrative and representations. It is thus well adapted to the study of discourses on outer space and add to existing studies on the construction of outer space by focusing on power imbalances that both shape discourse and are reinforced by them. This article centres on discourses, which can be defined as "an ensemble of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is

produced and reproduced through an identifiable set of practices" (Hajer & Versteeg, 2005: 175). Central to discourses on outer space are the concepts of representation (how phenomena are represented, and what are the consequences of theses representations) and sociotechnical imaginaries, that Jasanoff and Kim (2009) define as "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects". It is necessary to highlight the presence of (dominant and non-dominant) discourses to enable contextualising how knowledge produces social realities.

Discourses are representational practices that produce knowledge and organise social action; they shape and are shaped by society (including power structures and ideologies). In that sense, they are constitutive and constituted (Fairclough, 1992). Dominant discourses on outer space do more than just 'describe' it (symbolic representation): they define which facts count, which actors are legitimate, which problems are visible, and which solutions are acceptable. Because these representations are taken up by institutions, experts, and sometimes society, they shape policy choices and everyday practices and thereby have concrete social and material implications (Van Dijk, 1993). This article contributes to the understanding of discourses and resulting practices by tracing how they translate into policies and outer space governance. In doing so, it exposes how discursive formations can depoliticize decisions and obscure geopolitical motives, revealing processes of anti-politics and anti-geopolitics that follow from particular ways of representing outer space. This article argues that four discourses have shaped debates and practices concerning outer space. Rather than performing a discourse analysis *per se*, this article traces how these established discourses have fostered a "privatization-securitization nexus" and enabled and normalised anti-politics practices. It draws on documents and illustrative examples from governmental and intergovernmental actors; these are not exhaustive but are chosen to illuminate widespread practices and imaginaries.

We identified a theory-derived set of discursive frames (four representations of outer space) grounded in the literature and informed by established typologies of nature. Indeed, we consider outer space as another natural space, whose meanings are historically and culturally produced. Building on Germond-Duret (2022)'s Horizontal Reciprocity framework, which describes how norms and practices diffuse from land to sea, we argue that contemporary imaginaries of outer space are shaped by dominant terrestrial discourses about nature. Discourses on Nature offer a cognate frame for analysis to understand the broad categories of knowledge systems underpinning representations of the natural, and *a prior*i non-human, spaces around us. Outer space shares some distant similarities with the terrestrial and marine natural world. In particular, the Western dualism that establishes boundaries between nature and culture reflects in the construction of space as a void (notwithstanding the debates and critiques regarding this dualist view; Haila, 2000: 155-170). Outer space is also constructed as a 'natural resource' (Anderson et al., 2019), a 'global resource' (Beery, 2016) or simply the 'environment' (Klinger, 2019). It is subject to 'environmental' threats, as exemplified by space debris pollution; Klinger considers human engagement with outer space as a question of environmental justice.

The analyses of discourses on nature have centred on the different approaches towards the protection or management of the natural environment, to go beyond the simplistic 'weak' versus 'strong' sustainability dichotomy. The different categorisations and classifications of narratives and representations tend to show that the most influential discourses on nature

are underpinned by techno-optimism and utilitarianism. For instance, Dryzek (1997) identified four basic environmental discourses: problem solving, limits and survival, sustainability, green radicalism; Bäckstrand and Lövbrand (2006) highlighted the discourses of ecological modernisation, green governmentality and civic environmentalism in the case of forest plantations; and Vanhulst and Beling (2014) reviewed the emergent discourse of *buen vivir* ('good living') within debates on sustainable development and the idea of interdependence between nature and society.

Similar underlying ideas can be found regarding outer space discourses. Indeed, whereas competing discourses about outer space have a variety of underlying cultural, political, ideological or scientific underpinnings (and notwithstanding subaltern representations that disagree with the representation of outer space as a lifeless void, see Mitchell et al., 2020), they all derive from factual, material, so-called 'natural' realities about outer space. It is seen as "theoretically and practically infinite", and totally "unhospitable" (Mendenhall, 2018: 109). Consequently, in mainstream narrative at least, outer space is mainly characterised (both as opposed to earthly spaces/places, and in essence) by its 'otherness': it is extra-terrestrial, alien. This 'otherness' means that understanding, exploring and using outer space is extremely dependent on science and technology (Bichsel, 2020: 3), so it is the realm of 'expertise' before anything else, i.e. before social, political, and even ethical considerations and constraints. Consequently, scientific knowledge is key to the production of geopolitical narratives and the construction of outer space in a way that "has enabled new political reconstructions and political actors" (Saperstein, 2021: 732). In other words, "it is labs and scientists who hold much of the power in creating outer space imaginaries, and, consequently, in creating the imaginaries of Earth that come from them" (p.742). In addition to technicality, the 'otherness' and 'uninhabitableness' of outer space also contribute to making it perceived as useful mainly through its commercial or security value, which fits with a utilitarianist narrative.

Based on the above, we have identified four competing, but interrelated, discourses that all derive from the principal characteristic of outer space as conceived in mainstream imaginaries, that is, its *otherness*:

1) The 'Global Commons' discourse suggests that the 'other' must be regulated and serve states' interests (e.g. Beery, 2016; Brünner, 2011; Mendenhall, 2018);

2) The 'Final Frontier' discourse suggests that the 'other' must be 'colonised' (de Witt Kilgore, 2003; Genovese, 2017; Sage, 2008; Vidmar, 2020);

3) The 'Earth 2.0' discourse claims that the 'other' is a source of profit and instrumental for the future of humanity and must be 'domesticated'. (e.g. Geppert, 2012; Rahder, 2019; Popper & Rakotoniaina, 2019);

4) Finally, the 'Out of Reach' discourse claims that the 'other' is predominantly beyond our reach and not of immediate or urgent importance for humanity (Mitchell et al., 2020).

Representation and dominant discourses are mutually constitutive. Thus, in practice, these four discourses have normalised a particular representation of and have influenced the practice of outer-space governance in general and security in particular. As with any grand discourse (here the outer space discourse), there are dominant discourses and minority discourses that "compete for hegemony"[3]. The four main discourses discussed below are all competing for discursive hegemony, but they also share some similarities, either at the

underpinning level, narrative level, or practice/performative level. As a result, they combine in shaping the outer space governance regime, and, as we argue below, contribute to making it a technical, anti-politics and anti-geopolitics endeavour.

To deconstruct geopolitical narratives and their underlying power structures, we proceed in four main analytical steps. The first step consists in identifying the ideologies and ideas that underpin each discourse. The second step consists in highlighting the way an object, an actor, a relationship, a process, or a geographical space (in this case outer space) is represented and thus constructed at a certain time in a certain way and by certain actors. The third step consists in analysing the practical consequences of representations and narratives (or in other words how the discourse is then performed), insisting on discourse institutionalisation (e.g. impacts in terms of governance). Steps two and three enable the further discussion of the discourses' effects in terms of knowledge and/or policy outcomes. It is finally possible to draw conclusions on how competing discourses normalize dominant practices on a particular topic (in this case the governance of outer space). In this article we will focus on the impacts on security governance of outer space and the role of private actors.

The construction of outer space: competing discourses and their practical implications

Outer space as a 'Global Commons'

Outer space as a Global Commons has been the main discourse since the beginning of the space (exploration) age. It is underpinned by geopolitical realities and imaginaries as well as legal constructions. Since space exploration started in parallel with the Cold War strategic confrontation, superpowers (and big powers with the potential capacity to use space) wanted to secure free access to space (i.e. no sovereign rights over space, no territorialisation akin to territorial waters or sovereign airspace) as well as preventing the nuclearization of space. This resulted in the 1967 Outer Space Treaty (OST) that has often been compared to the Antarctic Treaty and gave birth to the narrative whereby outer space is a 'global commons' or a 'global resource' (Beery, 2016: 102). The origin of this discourse is intertwined with the foundational principles of space law, particularly the idea that outer space is not subject to national appropriation and should be used for the benefit of all humankind; the OST enshrines these principles, emphasizing cooperation, peaceful use, and shared responsibility (Brünner, 2011). Geopolitical realities were thus embedded within international law and the UN system that govern international relations since World War II.

The Space Race has from the start been linked to war and military considerations; rockets being just a civilian iteration of ballistic missiles. But it is not just the fungibility of resources and technologies, but also the mindset. War and geopolitical tensions go hands in hands with a desire for exploration and 'progress' (which is then linked to the second discourse). But this representation started even before the actual Space Race (Sage, 2014). For example, in his novel *From the Earth to the Moon*, Jules Verne employs the military technology of his time to envisage space travel (i.e. canons rather than missiles as vectors of space travel) but, furthermore, Verne's novel exposes the links between war and innovation at an almost psychological level. Indeed, the whole idea of travelling to the moon originates in the fact that the Baltimore Gun Society and his president Barbican did not really know what to do following the end the American War of Secession. Thus, exploration replaced war as the motor of innovation. In fact, members of the Gun Society were in search of a use for guns which would not be linked to the horrors of war, so Verne had already identified and criticised the links

between war and innovation. In fact, science-fiction has been closely linked to military imaginaries and space exploration to defence, including defence against asteroids. And the boundary between science-fiction, speculative research, futurism and anticipation is thin, for example war gaming makes use of immersing video games for military training (Bos, 2018; Genovese, 2017: 45-50).

The narrative attached to the Global Commons discourse revolved around the concept of 'freedom of space' that mirrors "freedom of the seas", i.e. outer space is free for all to explore and exploit, and states' actions are regulated, limited by international law. In other words, outer space is constructed as a 'common heritage' of humanity. This narrative is reinforced using technocratic, legal representations (championed by international lawyers more than space scientists), such as assimilating outer space with the high seas, the seabed, or Antarctica (Mendenhall, 2018: 1001-103), which are characterised by their situating outside the scope and reach of sovereign states' territorialising grasp.

The Global Commons discourse put outer space firmly into the hands of states (and their military forces), which operate in space, and of the UN and international law that regulate states' activities. However, this discourse has contributed to normalizing unequal access to space and thus unequal benefits from space. Indeed, during the Cold War, the *de facto* outer space regime served the interests of both the US and the Soviet Union, whose practice of power politics could be unleashed in space (Blount, 2012). At the same time, this practice resulted in a condominium over outer space with periods of cooperation as well as arms race. For instance, the question of strategic missile defence was a salient point of alternatively cooperation (ABM treaty) or conflict (US "strategic defence initiative" in the 1980s, better known as "star wars") (Bowen, 2022: 243). Even following the invasion of Ukraine in 2022, Russia and the US did not (and perhaps could not) stop all forms of cooperation in space, especially regarding the International Space Station.

With the advent of new technologies allowing for smaller, less expensive satellites and private space companies to launch them, space is now represented as somehow freely accessible to less developed international actors (Collis, 2009; Kojima et al., 2018). However, this ignores the fact that this may not be desirable or efficient for developing states and, in turn, demonstrates that "economically and technologically advanced states have secured a construction of outer space favorable to their continued political and economic interests and to the structures that support those interests" (Beery, 2016: 99). Moreover, there has been a gap between the representation of space as a 'global commons' and the lack of "joint responsibility of national governments to look after the space environment and prevent its uses for nefarious purposes" (Retter et al., 2022). Indeed, the space regime initiated by the Cold War superpowers and crystalized into the OST reflects and perpetuates earth unequal balance of power. This space regime focuses on international relations and security as well as international law; it has led to some efforts to regulate private actors in outer space, but they are mostly free to exploit resources and opportunities.

In fact, when the OST and other space law documents of the 1960s and 1970s were drafted and negotiated, they served the purpose of averting the immediate nuclearization of outer space and the additional language inserted regarding the "common heritage of mankind" was considered in the context of private actors of the time and not as we understand them today. Private actors today have different characteristics that explain why the very idea of a common heritage of mankind is not operationally applicable to NewSpace actors, structures and relationships with state actors in the 21st century. As such, debate has occurred as to what

these laws do allow for and, whilst there are two sides to this, the side of unfettered freedom seems to prevail as one can observe with the United States and Luxembourg passing national legislations to facilitate new space mining companies by allowing resources acquired to be freely sold in their respective states and, in the case of the latter, the European Union (Cookson, 2021).

In terms of security, the regime does not prevent the militarization of space (like UNCLOS does not prevent the military use of the high seas, on the contrary). The 1966 OST requires space exploration and activities in outer space to be "in the interest of maintaining international peace and security" (UN General Assembly, 1966) and the Moon and other celestial bodies shall be used for peaceful purposes (i.e. military bases and manoeuvres as well as testing of weapons are prohibited). However, legally, the OST only prohibits the deployment of nuclear weapons in space not conventional weapons such as ASATs. And the majority of space technology is "dual use," meaning that it is difficult to distinguish objects based on their potential for peaceful or aggressive use" (Mendenhall, 2018: 113). As such, the Space Race played (and still plays) an important role in demonstrating one's military capabilities and one's potential capacity to use space for defence purposes (Genovese, 2017: 72-72). For instance, the Chinese CCP relates China's growing space capabilities (such as its Tiangong space station) to Beijing's great power politics. Same is true of India's and Japan's civilian space capabilities that are not only regarded but constructed as an indicator of their "rank" within the international system (Blount, 2019: 6; Bowen, 2022: 82). Like the number and size of warships still contributes to states' prestige within the global pecking order (Germond, 2024), the capacity to operate in and from outer space reinforces one's extrinsic, perceived power. The 1979 Moon Agreement prohibits even more clearly the militarization of celestial bodies, but none of the space-capable countries have ratified it (UN General Assembly, 1979). This is not lost on scholars, who have identified the growing securitisation of the Global Commons discourse with traditional expression such as 'for all mankind' and 'peaceful uses' being surpassed by phrases describing space as "congested, contested, and competitive" (Blount, 2024, p.67). In sum, *de facto*, the outer space regime contributes to space Powers' communication, intelligence, and other military use of space, in the exact same way as freedom of the seas grants naval Powers with the ability to project military power all over the world.

Outer space as the 'Final Frontier'

As discussed above, national security and space exploration intersect. Whereas the Cold War rivalry has been instrumental in generating incentives and resources for space exploration, the 'unearthly' nature of outer space has made it connected to science-fiction (Genovese, 2017). The boundary between what is possible to do, what we try to achieve with the means we have at disposal, and what we dream of being able to achieve in outer space has been thin. As such, space exploration has been underpinned by the idea of transcendence (Sage, 2008), i.e. the inevitability and the necessity of 'progress' (often considered an attribute of human nature). The Final Frontier discourse finds its origin in humankind's obsession with progress and comprehending the unknown but also in the practical expansion of technological capacities and scientific innovations. In turn, these new possibilities have also exercised fascination and generated excitement within the wider public:

> "This 'final frontier' attracts not only curiosity, but also a degree of admiration. The inherent mystery of what is unattainable by direct experience has been an age-old source of social power – and the technoscientific means with which it is exerted give rise to similar phenomena" (Vidmar, 2020: 59).

The Final Frontier discourse draws from what Kilgore termed "astrofuturism", i.e. "the tradition of speculative fiction and science writing inaugurated by scientists and science popularizers during the space race of the 1950s" (de Witt Kilgore, 2003: 2). Thus, everything is presented as possible or within the realm of possibilities. Consequently, space exploration, from the start, has been linked to the idea of progress and the desire to push the boundaries of humanity. There is almost a transcendental element of outer space exploration that features centrally in "astroculture" with deeper routes in "epistemologies of the supernatural and the theological beyond" (Geppert, 2018: 15). The Final Frontier is strongly linked to the very American concept of Manifest Destiny (Popper & Rakotoniaina, 2019: 2; Sage, 2008). Space exploration has thus unashamedly been represented by its proponent using "imperial tropes" and "visions of settler colonization" (Redfield, 2002: 792, 799). At the same time, it is also linked to private entrepreneurship, "pioneering, free enterprise and rugged individualism" (Popper & Rakotoniaina, 2019: 2).

That said, it is of note that despite its glorification of technological progress and innovation, Soviet outer space was imagined less as a liberal frontier for individual entrepreneurs and more as a scientifically planned, collective project. Breakthroughs in space exploration were presented as a proof that socialism worked. In Soviet discourse, outer space was framed as a collective validation of socialist modernity, mobilizing "cosmic enthusiasm" at home while posters and slogans such as "Socialism is our launching pad" linked every orbital "first" to party-led science (Gerovitch, 2015; Siddiqi, 2011). Still, space exploration was seen through the lens of an endless realm of possibilities.

As a frontier, outer space has been represented as a site of riches, knowledge and power that are there for the adventurers or entrepreneurs to grab. This "projects a romanticized vision of the American frontier - one of opportunity, freedom, adventure, and untold profits" (Genovese, 2017: 54). Although this could not be the case until the 2000s when private actors literally *went* to space (and still at a prohibitive cost and at such a limited rate that does not mirror the Gold Rush), the narrative has been present in media, literature, cinema, and video games from the start of the space age, from space operas such as Star Wars to universe-building and role playing games such as Eve Online. This has contributed to constructing space exploration as something 'natural' for humanity as well as fascinating, akin to the great Discovery Age. Real astronauts and fictive space explorers have been represented in a heroic manner (de Will Kilgore, 2003; Vidmar, 2020).

The Final Frontier discourse constructs outer space as the realm of the 'Law of the jungle', but one which is idealized (e.g. a romantic vision of the Wild West that we find in 'space westerns' such as Star Wars): the realm of adventurers, where attributes such as bravura and strength are idealised (Mendenhall, 2018). So, in narrative anyone can be an actor of space adventure, but in practice powerful actors (individuals and corporations) are in charge and mostly benefit from it. The Final Frontier discourse has thus reinforced states' ability to do everything they want in space (barred the legal limitations mentioned above and within the realm of scientific

possibilities) and contributed to positioning non-state actors at the forefront of space adventure.

In terms of security, the Final Frontier discourse contributes to normalizing the fact that public and private actors will defend their interests with all the means at their disposal and within the boundaries of what is reasonable to do in line with national interests. Even China casts space exploration as a state-led national rejuvenation project. Although Beijing stresses the peaceful and scientific use of outer space, this cooperative narrative rests on tight civil-military integration/fusion, which aligns commercial growth with defence, security and prestige objectives, enabled by the tight control exercised by the Chinese government over private actors (Bitzinger, 2021). International space law will still constrain what is possible to achieve, but (and this is especially true for private actors) outer space facilitates 'out of sight out of mind' behaviours. So, like pioneers in the Wild West were occasionally in need of the Cavalry (when the threat was beyond the local sheriff's abilities), outer space is constructed as in growing need of policing.

For example, one of the core competences (or missions) of the US Space Force established in 2019 is 'space security', i.e. "establishing conditions for the safe and secure access to space for civil, commercial, Intelligence Community (IC), and multinational partners" (US Space Force, 2020: 35)[3]. Interestingly, the establishment of the US Space Force follows Donald Trumps's proclamation that outer space was the "next great American frontier" (NASA, 2017). Similarly, the Space Force 'Capstone Publication', *Spacepower*, is dedicated to "past, present, and future spacepower *pioneers*" (US Space Force, 2020: ii). This lexicon and related representations illustrate the close links between space exploration, national security and defence, and peacetime security and stability of outer space (for public and private actors to operate safely) all under the banner of the frontier narrative. This echoes Maclaren's argument that a "nationalistic iconography" has been key to the American space programme and that it "further reflects American Manifest Destiny in outer space, with outer space seen as a place of American leadership, achievement and thus exceptionalism" (2021: 763). Even though not framed as a libertarian project, China's space narrative also contributes to this discourse on outer space as the realm of endless possibilities at the service of national interest. And indeed, in the context of the US-China global leadership challenge, space remains a terrain for competition and possible conflict (Pollpeter, 2020).

Outer space as Earth 2.0[4]

Whereas the Final Frontier discourse is underpinned by the American myth of the Manifest Destiny, transcendence, and adventurism, the Earth 2.0 discourse is an assemblage of scientific narratives, techno-utopianism, and a pessimistic assessment of the future of planet Earth. For example, the Kardashev's scale that measures the "advancement" of a civilization according to the energy that it can muster and use (1964), has generated expectations in terms of space exploration. Indeed, according to this thesis, 'progress' and the survival of civilizations on an astral timescale is linked to one's ability to harvest energy from outside our atmosphere. So, the Soviet discourse represented outer space as a vector to reach the next stage in socialist development with utopian narratives setting space exploration within a

[3] It is interesting to note that this 'competence' is listed first, followed by 'combat power projection', 'Space mobility and logistics', 'Information mobility', and 'Space domain awareness'.

[4] The expression is borrowed from Rahder (2019).

communist ethics of progress (Gerovitch, 2015; Siddiqi, 2011). Today's Earth 2.0 discourse draws from a mix of belief in 'progress' (not unlike the Frontier narrative) and technology, a realisation of the limitations of the planet in terms of energy and resources as well as entrepreneurism of private actors willing to embark on bold futuristic programmes. This discourse is also closely aligned with post-modernity, 'end-of-worldism' (now reinforced by a "climate catastrophe discourse"; Rahder, 2019: 160), as well as hyperreality and space science hyperreality (Genovese, 2017: 158-159) narratives[5]. However, it is also aligned with more traditional capitalist narratives in regard to profit making and the economically rational desire to benefit from the resources provided by outer space. This is thus linked to a cornucopian vision of the universe with asteroids represented as full of ore, water and gas ready to be exploited. Such narratives are backed by a clinical, techno-utopian (Geppert, 2012: 5-6) representation of space and space operations, ships, and bases. The concurrent development of cyber and artificial intelligence technologies has further reinforced the representation of space as the realm of possibilities based on a renewed technological utopianism that is salient in recent movies and video games but also in governments' narrative.

Here, the central narrative is that humanity's salvation passes through the conquest of space and the use of the knowledge and resources we gain from space to overcome the limitations of the planet Earth. In other words, space exploration and exploitation (e.g., asteroid mining) are constructed as the latest stage in human civilization's evolution or even survival: "a necessary step in human social and evolutionary history" (Rahder, 2019: 58; Popper & Rakotoniaina, 2019: 2).

It is in this context that private, corporate space actors (usually labelled as NewSpace[6]) have begun their rapid growth. Scholars have demonstrated that the privatisation of space activities is a continuation of the Frontier narrative since it is also based on astrofuturism and entrepreneurship and relies on colonial tropes and a romanticised representation of space exploration (Genovese, 2017: 98; Geppert, 2012: 3; Popper & Rakotoniaina, 2019: 2-3; Rahder, 2019: 160). However, there is an additional commercial dimension that further dominates the narrative: Earth 2.0 is more about exploitation than exploration: progress is constructed in a commercial way "as a site for capitalist accumulation" (Genovese, 2017: 129).

As such, the Earth 2.0 discourse enables and sustain the ongoing privatisation of space operations and encourages public-private partnerships. NewSpace companies have constituted a renewed source of funding and expertise that traditional, state-led, stakeholders of space exploration, such as NASA, have welcome (Genovese, 2017: 77, 84; Rahder, 2019: 162). Eventually, public-private partnerships to advance space exploration and exploitation are normalized as is a post-modern governance system for space in which corporate interests transcend states (public) and individual (people) interests in a way that is naturalised, i.e. 'this is the only future, there is no alternative'. NewSpace personalities, such as Branson, Musk and Bezos, and corporations take almost precedence, at least in narrative, over old sites of power such as NASA and Pentagon. It is not surprising that Marxist critiques then consider that Earth 2.0 is not about the survival of humanity but the survival of capitalism via "galactic imperialism" (Dickens, 2009: 163; Dickens and Ormrod, 2010). Other criticisms

[5] See also Rahder (2019: 163)'s point about "Earth 2.0 imaginaries [being] a kind of pressure release for Earth-bound human problems".

[6] For a discussion of the origin and definition of NewSpace, see Denis et al. (2020).

include the risk that privatized space exploration will contribute to "ideologies of a disposable planet" (Rahder, 2019: 163) and that this narrative is resigned to the inevitability that the Earth is already beyond repair with mankind soon to follow without an escape to the stars whilst not accepting that humanity's relationship with the environment bears responsibility (Dunnet et al, 2019; Klinger, 2019). NewSpace narrative is also criticised as it constructs happiness and freedom for human beings as being dependent on machines (Popper & Rakotoniaina, 2019: 3).

In terms of security, the privatization of space has modified strategic and security objectives linked to outer space. State-centric defence objectives, such as using space and space-based weapons and satellites to gain advantage in peace and in war (e.g. surveillance, intelligence) have been complemented with the need for security and stability of space operations. Indeed, whereas states are primarily driven by survival and national interest (including economic prosperity), private stakeholders in the space sector are for-profit actors. They are driven by business continuity and profit and thus thrive for a safe and secure operating environment. As such, they are depending on states for regulations, order and security and at the same time they provide states with the means to control and secure space. In other words, the privatization and securitization of outer space have worked hand in hand. The Earth 2.0 discourse emphasises the importance of space for humanity, which normalizes the need to secure space. The creation of the US Space Force has been framed with a techno-utopian vision of space exploration and exploitation mixed with the securitizing of outer space whereby with the advancement of private actors in space governments are facing the prospective need to police activities in outer space, including potential rogue actors (Gunn-Golkin, 2018).

In the same vein, there is also a renewed interest in space defence against asteroids which goes along the Earth 2.0 narrative, i.e. humanity's salvation passes through our domestication of outer space. This also includes planetary defence capabilities, i.e. preventing big asteroids from hitting the Earth with all that this entails. NASA's recent Double Asteroid Redirection Test (DART) has been a success (NASA, 2022), which has reinforced perceptions that cataclysmic catastrophe can be avoided thanks to our mastery of technology (and our ability to 'domesticate' outer space). Yet, whilst diverting such rocks from unfortunate trajectories, there remains the possibility that such technologies could also be utilised against earth-based adversaries and that the ideals of collective planetary defence can end up in militarisation or even weaponization projects (Pražák, 2021).

For their part, private actors contribute to space security in collaboration with governments. SpaceX, for example, is contracted to launch US military satellites. However, the partnership has limitations since private actors have financial imperatives that might not always be compatible with geostrategic ones. For example, SpaceX, which has been providing crucial communication infrastructure to Ukraine since the beginning of the war with Starlink satellite internet terminals, is simultaneously asking the US Government to take over the financial burden of the operations that are estimated at hundreds of million dollars (Marquardt, 2022) whereas Ukraine's dependence on Starlink is obvious. In February 2023, SpaceX restrained the use of Starlink to control offensive drones claiming that it was "never meant to be weaponized" (Roulette, 2023). This illustrates the difficulty for corporate space actors to navigate the porous boundaries between civilian, dual use, and military activities. With the increasing leverage of the private space sector, tensions between state/national interests and corporate/private interests are increasing (Doboš, 2022). The more geopolitical tensions

between states the more challenging it will be for private actors whose involvement in security and defence activities, whether directly or indirectly, will be both expected and scrutinized.

A final point is that the Earth 2.0 discourse constructs the idea of a 'clean future' or a 'fresh start' in space (Shankar, 2017). Whilst, as noted above, there is a great deal of focus on this topic from the realm of avoiding impending doom or taking an 'inevitable' next step, this narrative also implies the aim of avoiding past mistakes (on/with Earth) and the hope to do better (in/with space) – a *tabula rasa*. However, "space expansionists rarely consider the possibility that the [negative] patterns of human activity [...] might be carried into space along with the spread of humans" (Deudney, 2020: 38), from space debris to unequal distribution of resources to 'environmental' degradations. Moreover, ignoring what limited prospects humanity might have to even undertake such a 'second chance' opportunity, this narrative pays little attention to whatever these grand mistakes were and, perhaps more critically, could serve as distraction from the imperative need to make radical changes at home if 'Earth 1.0' is to continue to serve as our home (Tutton, 2021; see also Klinger, 2019).

Out of reach

In opposition to the three above discourses that, each in their own way, represent outer space in a positive and opportunistic way, there is a competing one, which is also grounded in science but further draws from critical social science and humanities and proposes a more 'down on the ground' vision of outer space, which founds its origin in "terrestrial geocentrism" (Geppert, 2012: 4) and a sense of 'earthboundedness'. In this sense, it is closer to the discourse on buen vivir presented in the introduction. Proponents of this discourse do not totally refute the frontier nature of space: outer space is beyond earth and thus exists as an 'outside', but its main characteristics is to be 'out of reach' of human beings. Outer space is represented in opposition to Earth, with its own, unique characteristics; it is also represented as dangerous, "infinite", "inhospitable", and thus not susceptible of accommodating human beings (Mendenhall, 2018: 100). According to this narrative, NewSpace is accused of creating a simulacrum of hyperreality for their own corporate interests (Genovese, 2017; Tutton, 2021). Their aspiration regarding space exploration and Mars settlements are considered as more wishful thinking than self-fulfilling prophecy. In short, the Out of Reach discourse claims that we have dreamed up outer space and what we can realistically achieve there. For example, Geppert explains that, soon after the Apollo landing, we started to understand that we would not be able to achieve more (and more 'exciting' things) in several generations, hence the need to recentre on earth (Geppert, 2018).

Despite the underlying techno-utopianism permeating many aspects of human life on Earth, the social acceptability of space endeavours is not granted. Public opinion, activists and voters are generally more interested in what happens on land rather than with a geographically and ontologically distant realm to which they feel detached and unable to influence and be influenced by (Eliasoph, 1997; Germond-Duret & Germond, 2023). The Filipino space programme is a good example: the first attempt at passing relevant legislation focused on science and telecommunications, which were far from the minds of the average Filipino voter, was not successful, whereas the second, more successful attempt, instead focused on utilising satellites to mitigate disasters and support agriculture, a much less detached approach than the first (Verspieren et al., 2018).

The Out of reach discourse has the advantage of offering an alternative vision to the NewSpace, one which is grounded in a critical appraisal of corporate interests and operations in space. It also enables accounting for humankind 'insignificance' in the grand scheme of things and thus better reflect alternative and subaltern narratives (e.g., Mitchell et al., 2020). However, the narrative consisting in minimizing human beings' ability to operate in space entails the risk of generating "space blindness", i.e. a general lack of understanding and awareness of, and interest for, what is happening in space[7]. This is reinforced by the fact that the 'lucky few' who can afford space travel consist in a tiny minority of people, often invisible, despite NewSpace's attempts at publicising them with the use of 'celebrities'. The highly technical nature of any space operation also contributes to this detachment from what is happening 'up there', despite the growing number of daily news related to outer space.

Space blindness entails a risk of 'laissez faire' with public and private actors being accountable for their activities in outer space only to a limited extent since outer space remains beyond the realm of most human beings, resulting in the 'invisibility' of state and corporate activities. If outer space is represented as 'unearthly', beyond reach, and eventually, an empty void, the risk is that this will simply give way to exploitation without rules or with bad governance[8]. In terms of security, space blindness could result in the many potential dangers (from private actors going rogue to asteroids to weaponization of space) not being taken seriously before it is eventually too late.

Table 1: Comparison of the four discourses

	Global Commons	Final Frontier	Earth 2.0	Out of reach
Ideational underpinning	-Geopolitics -International law	-Human nature -Manifest Destiny -Astrofuturism -Entrepreneur-ship	-Science (and evolutionary science) -Techno-utopianism -Entrepreneurship -Post-modernity and 'End of the worldism' -Space science hyperreality	-Science -Critical theory in social sciences and humanities -"Terrestrial geocentrism" (Geppert, p.5)
Narrative	-Like freedom of the seas, there is freedom of space, i.e. no sovereignty claims over space; space must remain free for all to use	-Riches, knowledge, and power are there to grab -It is 'natural' for humanity to go as far as possible, to explore, etc.	-Human salvation passes through the conquest of space and the use of knowledge we gain from space -Space exploration and exploitation are the latest stage in human civilization's evolution or survival	-Outer space is inhospitable -Current projects are based on techno-utopianism

[7] The term 'space blindness' is an adaptation of 'sea blindness' to outer space. See Germond-Duret & Germond (2023).

[8] See Beery (2016)'s discussion of the way outer space has been represented as an empty space not unlike the sea, which based on Philip Steinberg's seminal argument in his *Social Construction of the Ocean* (2001) has normalized exploitative practices.

	-A certain degree of governance is required -Non-militarisation is stressed in narrative			
Symbolic representation	-Technocratic, legal representations -Space as high seas and seabed and Antarctica	-Heroism -Freedom -Wild West	-Clinical, techno-utopian place -Cornucopia	-Different, specific -Dangerous -Out of reach -Hyperreal
Practice and outer space governance (normalized and institutionalized)	-Unequal access and thus unequal benefits -Reflects and perpetuates earth unequal balance of power -Some efforts to regulate private actors but basically free to exploit resources	-Law of the jungle -Part of the global market	-Private-public partnerships to advance space exploration and exploitation -Post-modern governance	-Space blindness
Actors	-States (and their military forces) -International organizations	-Anyone in theory -The powerful in particular	-NewSpace personalities and corporations -States in collaboration with the above	-n/a -Rogue actors left under the radar
Security considerations	-Limiting the militarisation of space (*de jure*) -Space contributes to big powers' communication, intelligence and more (*de facto*) -Space crucial for national defence	-Public and private actors will defend their interests with all the means at their disposal and within the boundaries of what is reasonable to do in line with national interests -Securitization	-Need to police space -Space Force -Public-Private Partnerships (including for security) -Defence against asteroid	-Dangers (from private actors going rogue to asteroids to weaponization of space) not taken seriously enough

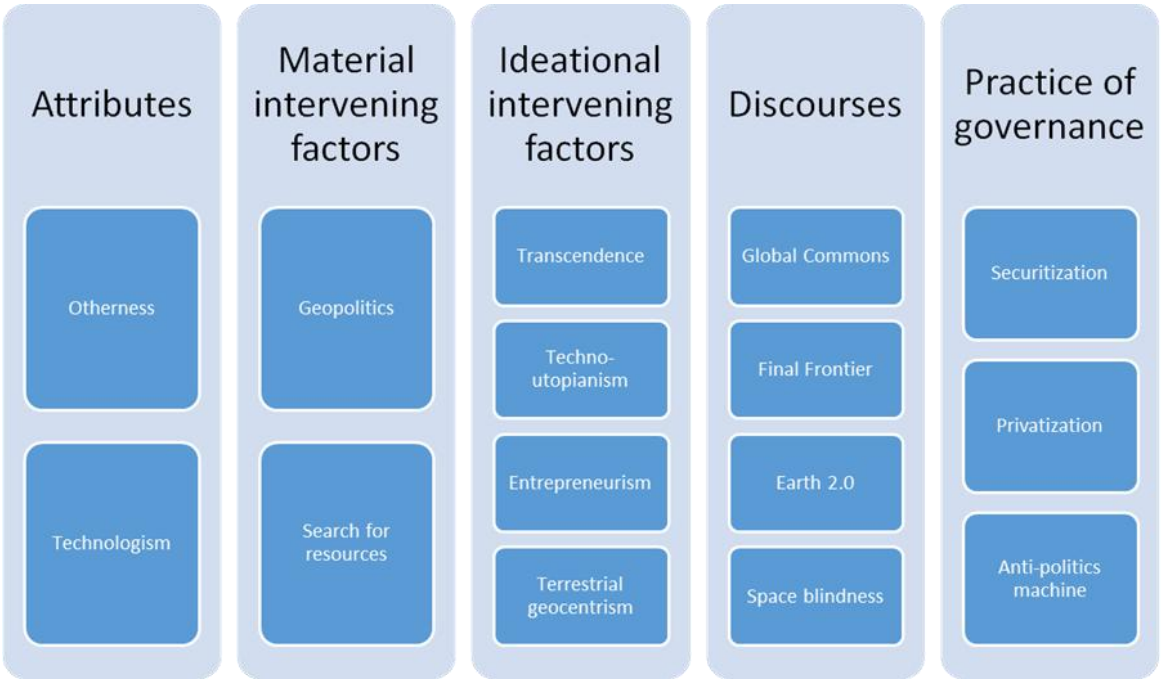
Table 1 shows that across the four outer space discourses, contrasts emerge in their ideational underpinning and then cascade through narrative, symbolism, governance

practices, and security implications. The Global Commons discourse is grounded in geo-power considerations and international law, emphasising "freedom of space" within necessary and acceptable governance frameworks. Its technocratic and legal symbolism translates into practices that reproduce unequal access and benefits, reflecting Earth's unequal balance of power while only partially regulating private actors. Dominant actors are states (and their militaries) and despite endeavours to limit militarisation *de jure*, in practice the importance of outer space for defence and national security is prominent. The Final Frontier discourse draws on human nature, the Manifest Destiny, astro-futurism, and entrepreneurship to assert that riches, knowledge, and power are "there to grab". Its heroism/freedom/Wild West repertoire legitimates a marketized "law of the jungle" ethos. Thus, actors can, in theory, be "anyone" but, effectively, the powerful; security follows a pragmatic logic in which public and private actors defend their interests within the boundaries of national and corporate priorities. The Earth 2.0 discourse brings together science, techno-utopianism, entrepreneurship, post-modernity, "End of the worldism," and "space science hyperreality" to claim that human salvation passes through space conquest and evolutionary survival. The clinical, techno-utopian/cornucopia imagery underwrites private-public partnerships and "post-modern governance" with actors centred on NewSpace personalities and corporations in collaboration with states. Security requires to police space but also to institutionalise PPPs in a way that brings reciprocal benefits to both sets of actors. By contrast, the Out of Reach discourse is underpinned by science, critical theory, and "terrestrial geocentrism", narrating space as inhospitable and current projects as techno-utopian. Its "dangerous", "out of reach", "hyperreal" symbolism points to "space blindness", where actors, including rogue ones, are left under the radar and security threats, from private actors going rogue to asteroids to weaponization, are not taken seriously enough.

Discussion: Securitization, privatization, and the anti-politics machine

The four discourses we have identified intersect in terms of their underpinning narrative. They have different outcomes in terms of practices of governance that are normalized and institutionalized (c.f. Table 1), but eventually they have a cumulative effect in that they all contribute, in their own way, to normalizing a practice consisting in fostering public-private partnerships for the use and security of/in/from space, influenced by entrepreneurship and liberty more than governance imperatives. Even the alternative discourse ('out of reach') contributes to this, because it results in space blindness and thus leaves the stage free for public and private actors to do as they please given the low level of public scrutiny. Combined, these four discourses facilitate the securitization and the privatization of outer space and of its governance. In combination, they blur the lines between geopolitics, science and entrepreneurship and between national interests, corporate interests and global interests. This contributes to a securitization-privatization nexus whereby outer space governance strongly rests on public-private partnerships that operate within a securitized/militarized framework (as summarised in Figure 1).

Figure 1: Outer-space grand discourse: from imaginaries to governance practices



Although findings show that Western or Western-influenced discursive productions still dominate global outer space narratives, the privatization of outer space is particularly salient in the US and Europe, but not prominent in Russia where the state still dominates the space business, and quite different in China where private, commercial actors are not operating as independently from the state as in the West (Doboš, 2022). In the US and Europe, the relationship between the public and private sector is bi-directional and even organic. Private actors contribute to space exploration, exploitation and securitization with their financial and technological assets. State actors regulate private operations in outer space, either nationally (e.g., through authorization/licensing) or collectively among states (e.g., through allocation of orbital slots and radio frequencies). Yet, powerful private space actors have a degree of leverage over states, which depend on their cooperation and operating for their own security and defence (Maraš & Dangubić, 2022). These dynamics are underpinned by the above-discussed narratives: in particular, the Final Frontier and Earth 2.0 discourses contribute to modelling private actors as contemporary privateers or at least promoting a neoliberal model of outer space supported by technical narratives and practices.

The analysis of the four discourses has shown that outer space has consistently been constructed as in need of security and at the same time as a security/defence enabler. Public and private actors will defend their interests with all the means at their disposal and within the boundaries of what is reasonable to do in line with national interests, corporate interests and international law. Thus, there is a securitization-privatization nexus in space. Space-based assets, including fully private or hybrid ones, contribute to states' communication, intelligence and more. Public-private partnerships operate within a securitized, if not militarized, framework. Additionally, the proliferation of actors in space requires policing outer-space that does not (so far) necessitate police presence in space but land-based control of outer-space actors, assets and operations. In all instances, regulations and governance mechanisms lack transparency. This opacity reinforces people's detachment from space affairs that the four discourses have normalized.

The technicality permeating all these discourses means that decisions are systematically left to scientists and other experts; 'those who know' (Saperstein, 2021: 744). Although science is rarely apolitical (Wallerstein, 2018: 1006), space exploration and its means have been constructed, and idealised, as an "apolitical endeavour" (Peoples, 2017) regardless of underlying political motives. Thus, outer space is subject to what Ferguson termed an anti-politics machine. In his critique of the development regime, Ferguson (2006: 273) claimed that "by uncompromisingly reducing poverty to a technical problem, and by promising technical solutions, […] the question of poverty is de-politicised". This results in "the suspension of politics from even the most sensitive political operations". The same happens in outer space where problems, solutions and actors are framed in a technical, technological, and often techno-utopian, way. Consequently, outer space decision-makers are less accountable to public opinion while at the same time detached from 'earthly' realities, which reinforces the securitization-privatization nexus. This anti-politics machine feeds the securitization-privatization nexus. Additionally, scientists who work for private companies must balance expertise and knowledge with corporate interests. This, in turn, reinforce the utilitarianist approach to outer space governance.

In discourse analysis, omissions are as important as what is said (Van Dijk, 2001: 106). It is thus striking to note that the four discourses (even the 'Global Commons') tend to neglect the geopolitical underpinning of the narrative. The scientific, legal, economic and corporate tone of the narrative has for effects to obscure the critical role played by geopolitics in explaining decisions related to space governance. It is thus possible to note the emergence of what we could call an 'anti-geopolitics machine', whereby outer space governance is presented as a technical, legal and corporate endeavour more than a (geo)political one. The anti-politics framing masks the political whereas decisions and their practical outcomes remain political or geopolitical. Whereas the four outer space discourses underpin policies and are at the same time driven by and driving geopolitical objectives, the representation of outer space and the resulting governance practice remain technical, apolitical and lacks any focus on societal and ethical implications, which ultimately serves the interests of the actors of space exploitation whether from an economic or military perspective.

Conclusion

The four discourses we have identified each tells a different story. The 'global commons' narrative emphasises the need to regulate space (mainly) in the interests of states. The 'final frontier' narrative represents outer space as a site for adventure that can be 'colonized' and exploited. The 'Earth 2.0' narrative constructs outer space as a source of profit but also as instrumental for the future of humanity and thus it must be 'domesticated'. The 'out of reach' narrative conceives outer space as being, in effect, beyond reach and thus not a priority area. Although varied, these four discourses are underpinned by similar conceptions of outer space as an 'other' as well as a strong technicality and utilitarianist vision of nature (and space) reflecting their Western underpinning. They also act synergistically in normalizing the privatization securitization nexus that characterises outer space governance.

Eventually, they reinforce both an anti-politics and an anti-geopolitics machine whereby decisions regarding outer space and security are increasingly disassociated from their societal, political, geopolitical and even ethical contexts and outcomes. Thus, this article adds to existing debates in the literature about the representation of outer space and the ensuing

practice by states and non-state actors by focusing on the concomitant process of securitization and privatisation at play that the grand discourses on outer space have normalised and reinforced. In particular, the article has shown that the underlying anti-politics and anti-geopolitics machine contributes to power imbalance in outer space. This also stresses the role played by outer space in legitimizing political visions and projects. From Kennedy and Reagan during the Cold War to the Trump administration and the Chinese Communist Party in the contemporary era, space power plays a key role both in terms of soft and hard power (Bowen, 2022).

Critical geopolitics is about finding out who benefits from these representations and the normalized practices. Whereas both states and private companies seem to benefit from an anti-politics machine in space, the balance has recently been shifting towards the private sector. To begin with, this poses risks to state defence and national interests, since technicality, opacity and the anti-politics machine contribute to an anti-geopolitics machine whereby the securitization-privatization nexus is removed from its intrinsically power politics core. Additionally, the increasing dominance of the Earth 2.0 discourse feeds directly into NewSpace corporate interests.

To what extent is the outcome of these discourses on outer space desirable? The grand discourse on outer space benefits powerful actors, public or private, but the question remains as to whether this contributes to efficient security governance. Indeed, PPPs in other sectors (such as maritime security) have proven efficient in addressing the complexity of challenges, threats, and actors in a domain that often escape states' jurisdiction and control.

Whereas a discourse that empowers already dominant actors is open to criticisms, the specificities of outer space require flexible, cooperative, multi-stakeholder mechanisms in order to address the challenges inherent to governance and given the anti-politics machine. Thus, we suggest the following policy recommendations: To remain sustainable, the organic relationship between public and private actors should bring reciprocal benefits. In other words, there must be return on investment for both sets of actors. For states, working with the private sector enables better domain awareness, flexible innovation and cost-sharing. For the private sector, strong PPPs enable privileged access to markets and secure the right to innovate knowing that the legal framework is there to support operations. Finding the right balance between outer space security, security of the space industry's supply chain in the current geopolitical context, commercial regulations, and property rights will be key to successful PPPs in space.

With an increase in public and private activities in outer space, whether justified by economic or security interests, the social and environmental sustainability of such endeavours needs to be put under scrutiny. The place of outer space within discourses on nature (e.g., nature to exploit versus nature beyond our reach) represents an important field of investigation to establish potential parallels and draw lessons from policies and practices developed on land and at sea.

In terms of future research agenda, we suggest that there is a need to put geopolitics at the centre of outer space debates. With sharper geopolitical tensions, outer space will increasingly be a site for defence more than for profit, which will require a shift in scholarship as well. More research is also needed on the 'othering' of outer space and on the technicality of representations and policies. What type of domain/site/place is outer space? How to foster multidisciplinary, or even interdisciplinary, research across not only the arts, humanities, and

social sciences, but also STEM disciplines? And what expertise is needed to counter the technicality of outer space enterprises?

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article.

Conflict of interest

The authors declare no conflict of interest.

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