

Spaceport America: Contested Offworld Access and the Everyman Astronaut

Katherine G. Sammler^a and Casey R. Lynch^b

^aGlobal Studies and Maritime Affairs, California State University Maritime Academy, Vallejo, California, USA, ksammler@csum.edu; ^bSchool of Geography and Development, University of Arizona, Tucson, Arizona, USA, caseylynch@email.arizona.edu.

ABSTRACT

Spaceport America, a spectacle to see with curvilinear geometry that itself looks like a spacecraft rising out of the desert near Truth or Consequences, New Mexico, conveys a hope of the everyman astronaut. Yet this private-public project, spending over \$200 million in state taxpayer money to build and with a \$2.85 million operating budget for 2017, does not provide the vertical transport analog of an airport. As Virgin Galactic stalls in launching its astronomically-priced zero-gravity music festival and commercial passenger flights, the facilities have been dusted off for educational rocketry club launches and Hollywood film backdrops while most public access to the grounds is restricted to expensive guided tours. As with the Spaceport, access to outer space itself raises questions of public versus private ownership and exclusivity. With the shifting role of nation states in offplanet activity, there are openings for outer space to become another site of capital accumulation or to manifest as envisioned by social movements and “community space programs.” This paper traces the ongoing realignment of public and private interests in offworld activity, of which Spaceport America is representative, considering how notions of offworld access have evolved since the aspirational vision of space as a commons laid out in the 1967 UN Outer Space Treaty. The paper juxtaposes the emerging public-private hegemony with the actions of three autonomous space organizations that actively construct alternative political economic models, technological systems, and cultural imaginaries of offworld access.

Introduction

The Federal Aviation Administration (FAA) of the United States has approved eleven permits for commercial spaceports across the country as of 2018, with reports of several others in planning and development stages. As the commercial space sector expands rapidly, state and local governments see spaceport development as an important opportunity to bet on future economic growth (CNBC, Sept. 13 2017). The State of New Mexico was the first in the world to wager on the future of commercial space activity, building Spaceport America using public funds in the town of Truth or Consequences, NM. Following state legal and regulatory changes and the establishment of a partnership with Virgin Galactic in 2006, these facilities opened officially in 2011. The building of Spaceport America represents a broader realignment of public and private roles in the outer space sector, in which states leverage public funds to develop the infrastructures needed for private ventures.

While the proliferation of commercial spaceports raises hopes of expanded access to outer space, we ask what kind of access is promoted by such a model, for whom, and under what conditions. Given that dominion over outer space has previously been established on a ‘first come, first served’ basis decided by national

economic and technical superiority, how is access being contested by private and civic interests? This paper considers Spaceport America a site of competing state, corporate, and civil society interests negotiating tensions in the political economic models, technological assemblages, and cultural imaginaries of outer space access. Recognizing that while the prospects of space travel, resource extraction, and offplanet colonies may seem far off, the discursive work and material efforts to secure the future of these endeavours for specific interests is already impacting communities in New Mexico and beyond.

This paper contributes to a growing interdisciplinary literature on the social relations of space exploration (Bainbridge 2015; Messeri 2016; Redfield 2000). In particular, we build on previous work in geography and related disciplines around the legal and geopolitical frameworks within which offworld activities operate (Beery 2016; Fox 2016; Glassner 1991; MacDonald 2007), while also stressing the role of cultural symbols, imaginaries, and practices, as well as the potential for radical alternatives. Several scholars have examined the important role of cultural imaginaries in the historical evolution of the space sector, including the use of nationalistic imagery, the figure of the heroic astronaut, and the notion of a universalized, singular “humanity” promoted through space ventures (Hersch 2011; Sage 2014). Others have considered how particular imaginaries and discursive framings shape the way scientists, policymakers, and the public perceive of and act in relation to both near-earth and far offplanet spaces and places. For instance, Messeri (2016) examines how scientists imagine exo-planets, constituting them as distinct places, while Olson (2012) explores how outer space becomes re-conceptualized as part of an extended “heliospheric ecology” and thus the object of environmental concern.

Yet, MacDonald (2007) highlights a relative lack of *critical* approaches to outer space at the current conjuncture, arguing that: “One paradox of our current phase of space development is that, unlike in the 1960s, popular imagination and interest has arguably not kept pace with technology.” This paper re-asserts the importance of cultural imagination in outer space development, in particular the potential for cultural imagination to challenge the emerging public-private hegemony and propose alternatives. As we show through our discussion of three “community space programs,” these alter-natives do not remain solely at the level of the “imaginary” but indeed fuel the development of new technosocial assemblages and political economic models of offworld access.

By juxtaposing the actions and discourses of states and large corporations with those of autonomous, community space programs and individual actors, we draw inspiration from and contribute to an anti-geopolitics (Ótuathail 1996) and feminist

geopolitics (Dowler and Sharp 2001; Hyndman 2004; Naylor 2017) of outer space. We seek to broaden the scope of who is seen as an outer space actor and which sites and scales are seen as relevant to political discussions around outer space. By considering how new geopolitical relationships are established and exercised through daily practices—like the maintenance of Spaceport America or its use as a film backdrop—we build on Dowler and Sharp’s (2001, 169) approach to “bodies as sites of performance in their own right rather than nothing more than surfaces for discursive inscription”. More specifically, our focus on the contested nature of offworld access builds on feminist geopolitics’ focus on “individuals and communities that push back, challenge, and rewrite geopolitical relations” (Massaro and Williams 2013).

In this paper, we trace the evolution of discourses and practices around offworld access in relation to state/military, corporate, and autonomous actors. First, we outline the rough contours of shifting state and corporate interests in relation to outer space at the current juncture, characterized by the rise of new corporate actors, and lay out a theoretical framework for understanding Spaceport America within these relations. We then examine the notion of outer space as a “commons” beginning with the 1967 Outer Space Treaty and NASA’s nationalistic imagery of the “everyman” astronaut. We compare these imaginaries to those of the Association of Autonomous Astronauts (AAA), a worldwide network of community-based groups dedicated to building their own spaceships, now defunct after completing a 5 year plan for obsolescence, but survived by new networks of experimenters. Next, we trace the shift in the new millenium toward the privatization of offworld activity, focusing on the role of state actors in constituting new outer space markets and the related shifts in cultural imaginaries around offworld access. In the following section, we discuss Spaceport America, its public reception, and its use for purposes other than commercial space launches. We then juxtapose the discussion of the emerging public-private model with the activities of the Autonomous Space Association Network (ASAN) and Copenhagen Suborbitals as examples of groups currently working to disrupt the neoliberal hegemony that projects like Spaceport America work to (re) produce (Franco and Spideralex 2014). Our focus on the figure of the “everyman astronaut” across these diverse projects is meant to both highlight the shifting and competing political economic assemblages of offworld activity, while also recognizing the commonalities across imaginaries of offworld futures.

To do this, we collected and analyzed a broad and diverse range of sources. To analyze the shifting public-private relationships around outer space access, we examined the texts of laws, treaties, public documents, and news articles about Spaceport America and the emerging private space sector. We also evaluated the

Spaceport America website, watched films and videos featuring the spaceport, and read online reviews from visitors and local residents. The specific sources were selected to demonstrate both how Spaceport America operates in practice (or fails to) within the broader outer space geo-political economy, as well as how it may shape broader public imaginaries about space exploration and the possibilities for future offworld access. To consider the actions and discourses of the three autonomous space initiatives, we analyzed the archive of AAA newsletters from the late 1990's available free online, as well as other texts published by AAA actors, like the 2003 collaborative book curated by Italian AAA member Ricardo Balli, *Anche Tu Astronauta* [You Too An Astronaut]. We analyzed the ASAN website, collected news coverage of the group's activities, and conducted an interview with ASAN Director General, "Laika Valentina," about their actions and perspective on offworld access. As ASAN was only recently established in 2016, this interview allowed us to gain greater insight into the group's values and vision, beyond the limited publicly-accessible information. Finally, we reviewed the Copenhagen Suborbitals website and blog posts detailing the technical and organizational model in which the group operates.

Throughout the paper, we employ the terms "offworld access" and "off-planet" or "offworld" activity. Much of the language typically used to describe offplanet activity – "colonization", "exploration", and "development" – invoke historical and ongoing relations of capitalism and colonialism and their reproduction in offworld futures. As it is precisely the reproduction of these relations that this article seeks to question, we have chosen the terminology "offworld activities" to more broadly represent both these imagined activities and other ways that humans may access, exist, and engage with outer space and offplanet places.

Space of Anticipation

Over the past several decades, the evolving and expanding nature of offworld activities and the emergence of new technologies and regulatory systems have created openings for new space actors. As Beery (2012) and Dickens and Ormond (2007) have pointed out, space-related activity has increasingly become a focus of private capital. The largest companies led by eccentric billionaires, like Jeff Bezos' Blue Planet, Richard Branson's Virgin Galactic, and Elon Musk's SpaceX, are focused on commercial passenger flights, exploration, and space tourism, while an array of smaller firms based primarily in North America and Europe are involved in developing new rocketry, launch services, and satellite technologies. The prospect of future space tourism has prompted discussions and debates around a myriad of

topics, including the future role of space tourism pilots (Goehlich et al. 2013), the need for new insurance schemes (Bensoussan 2010), and outer space business ethics (Livingston 2003).

The expansion of smaller, private, space-focused enterprises has also allowed governments in the Global South, universities, and research institutes to increase their offworld presence, particularly in Low Earth Orbit, by offering certain technical and logistical services at comparatively affordable prices (Woellert et al. 2011). While these activities are currently focused on scientific research, education, and communications, this trend has prompted interest in the possibility for future collaboration among this growing list of state and private offworld actors to allow for further deep space “exploration” (Ansdell et al. 2011). Beyond this, a growing number of regressive and right-wing utopian groups have sought to expand their activities to outer space, including a recent attempt to launch a satellite by the Flat Earth Society, as well as a successful launch by Asgardia, a group led by Russian-Azerbaijani scientist Igor Ashurbeyli set on creating the first independent nation in space. Yet, despite recent scholarly interest in the emergence of new private and state actors in offworld activity, there has been no discussion around possible alternatives outside the current public-private framework, nor an investigation of the radical and emancipatory projects that are emerging beyond this dichotomy.

Scholarly and popular writing on outer space exploration has long been interested in the “stuff” of offworld activity—from the rockets, and launch-pads, to the advanced computer technologies, satellites, and scientific instruments that allow offworld activity to take place. Indeed, space development is often seen primarily as a kind of technological feat, and the future of space exploration as simply a question of developing the necessary technologies and logistical systems to make it possible. While geographers and others have examined the “soft” infrastructures of law, regulations, and treaties and their roles in producing particular arrangements of public-private interests (Beery 2012; Collis 2009), the “hard” technologies are typically seen as less political. Yet, in questioning access to outer space, the role of rockets, satellites, spaceports, and other “hard” technologies can only be understood through the broader sets of relations through which they are developed, produced, maintained, and used—thus raising questions over intellectual property, finance, labor, and state power. We understand technology broadly, as the set of coordinated infrastructures, material objects, sites, protocols, laws, regulations, and treaties that allow for and organize offworld activities. Such an approach challenges the depoliticized techno-fetishism common in many discussions around offworld exploration. Spaceport America is one site where these infrastructures are

developed and applied while also capturing and deploying contemporary and anticipatory imaginaries of space travel and the space traveler.

Geppert (2012) highlights the importance of outer space as a place of imagination throughout the twentieth century—an imagined space on which competing visions of the future could be projected. Indeed, humanities and social science scholars have long examined the political content of space-related films, television series, art, and literature projecting alternative race or gender relations, the abolishment of private property, or different regimes of labor in an offworld future (Bould and Miéville 2009; Kilgore 2003; Lathers 2010; Marez 2016). Yet, as most authors admit, the majority of these forms of cultural production use outer space as an abstract space to project a critique of existing earthly social relations, rather than as a direct critique of ongoing offworld activities. While insightful, such critiques do not directly help us understand how contemporary cultural practices around outer space are linked to broader political economic and technological practices, nor do they address the ways grassroots movements directly contest offworld access in the present.

In considering the relationship among political economic, technological, and cultural aspects of offworld access, we understand Spaceport America as a “space of anticipation” (Thrift 2004) within a broader socio-technical politics of anticipation (Kinsley 2010) in which particular visions of the future are rendered present through the production of material infrastructures and artefacts. Such politics of futurity preemptively establish relations of power in an undetermined future. The spaceport is performative, linking political economic models, technological systems, and cultural imagination in an ongoing production of the present-future of offworld access. While it does not currently serve its intended purpose as a site offering commercial passenger flights to space, its existence, maintenance, and uses for other purposes reiteratively enact and reproduce particular relationships among state/military, corporate, and civil society actors in relation to space travel. Thrift (2004) and others use the term “technological unconscious” to describe the ways infrastructure is performative of particular sets of social relations, as spatio-material relations come to be taken for granted and naturalized through their repetition. The creation and maintenance of the spaceport preemptively establishes and naturalizes the public-private relations that take for-profit commercial space travel as the norm. As we show in the following sections, critics of this public-private hegemony are actively producing their own assemblages composed of new political economic models with alternative regimes of property and labor, their own technological systems, and radical cultural imaginaries.

Space for Everyone

Early human space flight was driven by the binodal space race between powerful Cold War nations, each promoting nationalist technological superiority. In the midst of this ideological contest, the 1967 United Nations Outer Space Treaty (formally the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies) brought all nations together to reserve offworld places and resources as the common heritage of all humankind. This ambitious agreement endeavored to lay out a global understanding of offplanet activities as not just the purview of rich nations, affluent individuals, nor wealthy tech corporations, but instead for everyone. The framework outlines how, “recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes, believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development [exploration] shall be carried out for the benefit and in the interests of all countries” (United Nations 1967, emphasis in original).

This notion that space exploration should be carried out for the benefit of all “humanity” inspired actions like the 1975 “handshake in space” in which, despite mutual suspicion, the US Apollo and Soviet Soyuz spacecrafts docked together in orbit, at least symbolically marking the end of the Space Race and a new era of international cooperation (Battaglia 2012). Yet, while calling for space exploration to benefit “all mankind,” the Outer Space Treaty maintains outer space as the purview of the nation state. It also specifies that outer space and offplanet resources are not subject to national appropriation or claims of sovereignty. While this treaty was drafted in response to state-sponsored programs, one provision designates that signatory states shall also bear responsibility “whether such activities are carried on by governmental agencies or by non-governmental entities” (United Nations 1967, Article VI). Access to this commons, even by a private or civil space venture, will be nationally supervised.

Founded in 1958, as a government venture, the National Aeronautics and Space Administration (NASA) has long projected an image of the everyman astronaut. NASA has presented itself as the organization responsible for pursuing knowledge of outer space for the benefit of all, and indeed much of the taxpayer-funded data is made available to the layman citizen. Launius (2008) and Hersch (2011) have examined how the constructed everyman image of the early astronauts involved in Project Mercury were vital to building broad public support for a space program, marking a sharp contrast to the less relatable physicists, mathematicians, engineers,

and others behind most of NASA's activities. In a similar vein, Sage (2014) explores the use of transcendental imagery and cultural imaginaries in building the U.S. Space Program. More recently, NASA's public outreach has created images of space farmers, surveyors, mechanics, and teachers, portraying space exploration as a public endeavor with future benefits for a diversity of people (Figure 1). Such images elicit desires for an offworld future from people with no immediate role in NASA activities in order to secure support for public funding. Further, these representations reproduce existing earthly relations of labor and their entanglement with relations of class, masculinity, and whiteness in an offworld future in the making.



Figure 1. Originally commissioned for an exhibit at the Kennedy space center visitor complex in 2009, these stylized posters are now made freely available to the public as downloadable digital files. Credit: NASA/KSC <https://mars.nasa.gov/multimedia/resources/mars-posters-explorers-wanted/>.

While projecting the ideal of the everyman astronaut has benefitted NASA's outward facing facade, long standing relationships with the Department of Defense,

the previous military experience of most astronauts, and the hierarchical military structure of NASA missions has had large influences internally (Levine 1982). As Hersch (2012) outlines, the question of who should become America's first space explorers was directed by military ideals, researched by Air Force psychiatrists, and ultimately staffed with Navy, Air Force, and Marine test pilots. Military discipline was an important component for 1950's researchers who worried "that such work would attract only suicidal deviants, and that merely participating in such a voyage would overwhelm the human psyche of otherwise healthy people" Hersch 2012, 32). Since these early days, some within the program have taken issue with the strict and hierarchical management of space programs, disrupting the image of the heroic everyman astronaut leading humanity into space and making visible a disciplined regime of labor and the astronauts' status as workers.



Figure 1. (Continued).



Figure 1. (Continued).

Eventually, an event surrounding the disciplined labor of astronauts briefly introduced some deviance to the NASA space program. The astronauts aboard Skylab, a collaboration between NASA and the Department of Defense operating from 1973 to 1979, “labored cheerfully on scientific research, complaining only when workloads became unreasonable” (Hersch 2012, 38). The grievance of these dutiful astronauts, however, is not to be dismissed. Sometimes unduly called the Skylab mutiny, the three man crew of NASA astronauts aboard Skylab 4, the first and only United States space station, staged an offplanet work stoppage for one day in 1973. Rejecting what Samir Chopra describes as the “panopticon-like control” and regulation of their bodies and labor, the crew turned off their radio and used the day for personal time.

While the exact details of the event are disputed—with at least one of the astronauts claiming that turning off the radio was simply a mistake (Hitt, Garriott,

and Kerwin 2008)–by all accounts the crew of the Skylab 4 in 1973 and 1974 had serious disputes with NASA ground control about work expectations (Compton and Benson 1983). As Commander Jerry Carr argued, “we would never work 16 hours a day for 84 straight days on the ground, and we should not be expected to do it here in space” (quoted in Harland and Catchpole 2002). The astronauts’ time was carefully scheduled to optimize time for experiments and observation with little to no free time. The schedule reflected a model of industrial-style efficiency, with the astronauts expected to produce as much data as possible in their time in space. As Compton and Benson (1983) point out however, the astronauts “did not share that philosophy; they felt their job was to turn out quality results, not merely some arbitrarily large quantity of data.” The astronauts wanted time both for personal care and for reflection. In the end, the work dispute was resolved through negotiations between the Skylab crew and NASA administrators on the ground, who were forced to reorganize the crew’s schedule and adjust expectations of data production. As one observer has described it: “a good old industrial action followed by negotiations with ‘management’ took place in outer space” (Open Magazine, Nov. 2 2013). The Skylab 4 crew redirected attention from the spectacle of space to the daily labor conditions in zero gravity and the vertical extension of politics from earth into orbit. Drawing attention to the conditions of daily human existence in outer space – drudgery, play, nourishment, sex – are topics that refocus these endeavors beyond state-centric geopolitics to scales of the corporeal and collective, radically altering the scope and targets of analyses. Such themes taken up by feminist geopolitical scholars, but also alternative space associations as discussed below.

Space Travel by Any Means Necessary

The Association of Autonomous Astronauts (AAA) was formed with the idea that outer space is fundamentally political. Active primarily between 1995 and 2000, this international network of “community space programs” included over thirty chapters across the United Kingdom, Western Europe, North and South America, and Oceania. They drew inspiration from the Situationists and psychogeography, using art, music, performance and other means to challenge the state, military, and corporate control of outer space, while presenting alternative visions of offworld access (Balli 2003). Key to this, was their challenge to established practices of knowledge production and expertise, writing “The AAA has resisted intellectual specialisation by promoting transversal approaches that combine different and diverse ways of thinking” (Inner City AAA 1998). By presenting offworld activity as a particularly technological and scientific feat, other forms of knowing and thinking have been excluded from the

mainstream space sector. The actions of the AAA thus sought to blur and contest the boundaries between different disciplines, asserting a space for politics, art, and sexuality in discussions of offworld access.

In contrast to NASA's representations of future space farmers, surveyors, and teachers, in the AAA imaginary, the everyman astronaut is not imagined as a good, laboring citizen. AAA actors see space as an opportunity to imagine new forms of social interactions (see Figure 2). In the realm of art, film, television, and literature, writers and artists have long projected alternative visions of offworld futures, from Afrofuturism to Star Trek (Marez 2016). Alternatively, some futurists have explored what space might look like if our current political and labor relations were extended offplanet, like *The Expanse* television and novel series exploring the 'geo'political tensions between Earth, Mars, and miners in the asteroid belt (political, military, and insurgent laboring classes respectively). AAA radically contests such reproductions of earthly social relations in the offworld future, imagining the

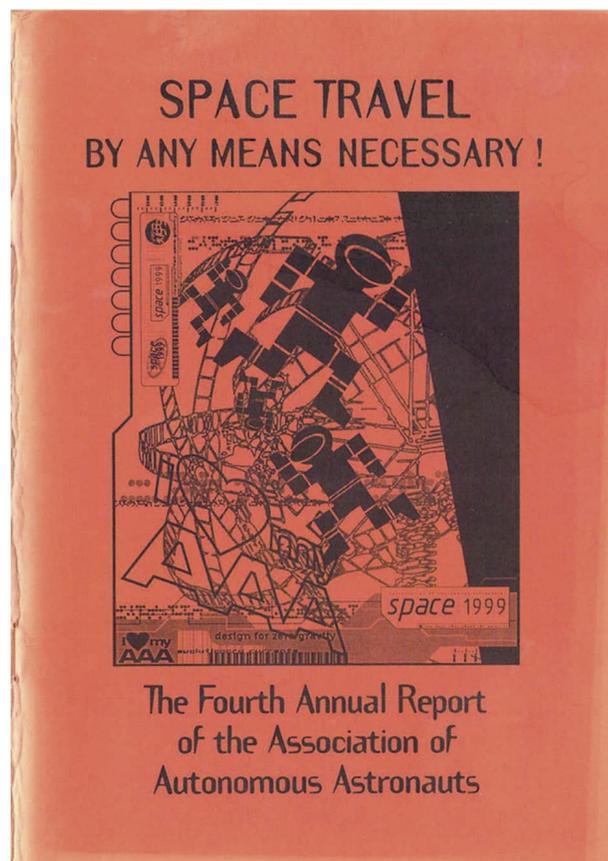


Figure 2. Cover of the Fourth annual report of the Association of Autonomous Astronauts (published April 23 1999, full report available at <http://asan.space/annual-reports-of-the-association-of-autonomous-astronauts>).

possibilities for horizontal social relations in a vertical environment. As one AAA publication laments: “You go all the way to the moon and all you can think of is to play golf.” AAA’s critique highlights the highly classed and gendered nature of NASA’s everyman astronaut—a white, middle class farmer/teacher/surveyor who golfs for leisure. AAA instead see space as a chance to rethink and reimagine notions of work/labor and leisure. London’s Inner City AAA focus their interest in exploring sex in zero gravity, space raves, and three sided football matches as ways of experimenting with new aesthetics and forms of relationality.

Inspired by the London Psychogeographical Society, the AAA sought to imagine an alternative earthly geography of space installations and infra- structures. In contrast to the regulated, capitalistic space of Spaceport America or militarized NASA installations, Inner City AAA located their “launch pad” on the aptly named Grub Street, a historical breeding ground of disreputable writers and artists in central London that was gentrified and renamed Milton Street in the Victorian Age. As they describe it: “The denizens of Grub Street created an atmosphere of sedition and revolt, of combat with the forces of law and order. Grub Street lay just outside of the old medieval city wall, and had always been a space beyond the control of city authorities” (Inner City AAA 1998). The Grub Street launch pad was meant to disrupt hegemonic modes of thinking and being in relation to space travel: “Now Grub Street must be reclaimed, not only by locating our launch site here, but also as part of a geography of the imagination, as a Grub Street of the mind that combines semiotic terrorism, self-confessed propaganda, information warfare, comical devices, cultural sabotage and a wicked, twisted sense of the absurd.”

While much of the AAA’s critique focused on the state and military control of outer space in the 1990’s, the group also recognized the early signs of offplanet privatization. In one newsletter article from the Raido AAA (UK) chapter, titled “Who owns outer space?” the author discusses the business model of “Lunar Embassy,” a company that purports to sell 1,777 one-acre plots of lunar territory for \$16 apiece. As the author explained, the company claimed the right to do so citing the U.S. Homestead Act of 1862 and comparing lunar colonization to the “Old West.” While it was clear the legality of such a model would face future challenges, the article points out that “It seems likely that the argument will revolve around who owns the moon and planets, rather than if such a concept is desirable in the first place.” Writing in the late 1990’s the AAA was concerned with the way capitalist and imperialist notions of property would dictate future offworld access, issues that are at the forefront of contemporary debates surrounding the privatization of offplanet activities and resources, outlined in the following section.

The Space Act and the Grounded State

NASA's budget has faced deep cuts for over a decade, yet the funding for NASA's controversial Commercial Crew initiative, a public-private partnership to accelerate private industry development of commercial space vehicles and crew systems, was doubled by the Obama administration. Discontinuing the Space Shuttle program and prioritizing private space companies for resupplying the International Space Station (ISS), in 2010, Congress declared that the priority goal of the ISS was "the economic development of Earth orbital space...[as] free and competitive markets create the most efficient conditions for promoting economic development, and should therefore govern the economic development of Earth orbital space...[using] free market principles" (Title 51 National And Commercial Space Programs). This reconfiguration radically changed the political-technological and vertical territorial relations between state and private actors. Even more, companies aspiring to mine resources on asteroids are pressuring national governments to protect their commercial claims. Demands to protect the profits of private enterprises in space directly counters the 1967 Outer Space Treaty banning the appropriation of outer space territory and resources.

Yet, even as an original signatory of this treaty, the United States Congress passed the Space Resource Exploration and Utilization Act of 2015 guaranteeing corporate profits (hereafter the Space Act). This regulatory framework allows for the commercialization of space resource exploration and utilization, protecting profits for United States commercial entities by granting them property rights. The Space Act states that "Any asteroid resources obtained in outer space are the property of the entity that obtained such resources, which shall be entitled to all property rights thereto" (H.R. 1508). If this resource grab is analogous to the Homestead Act, establishing private property without the prior foundation of state sovereignty, then this also could be the legal basis for the extension of state territory into this global commons. Eric Anderson, Co-Founder of Planetary Resources, Inc. claims that "[t]his is the single greatest recognition of property rights in history." Congress passed this into law in reaction to the "legal and regulatory uncertainties" inhibiting private entities from "developing the technical capability to explore and utilize outer space resources" (H.R. 1508, Background and Need for Legislation). While the inevitability of these ventures is beyond certain and this posturing might not seem significant until technology is much closer to making space mining a tangible and profitable endeavor, outer space is one of the most significant geopolitical zones of the 21st century. Leveraging ambiguity surrounding the requisite of state sovereignty to guarantee property positions the future of space resource commodification, both legally and symbolically (Klinger 2018). Reflecting this geopolitical realignment, Naveen Jain, Co-founder of Moon Express said in a 2017 CNBC interview:

My hope is that our landing on the Moon will be symbolic of what entrepreneurs are capable of doing. So imagine when we land on the Moon, not only [do] we become the first company ever to do so, we become the fourth super power. That just goes to show the next set of superpowers are likely to be entrepreneurs, whether it's Elon Musk or Jeff Bezos or Moon Express that's going to go out and solve the world's biggest problems. (Interview on Squawk Box. Tuesday, Jan 31 2017)

The territorializing of celestial bodies and outer space resources by private entrepreneurs serves to sidestep established international law. This changing role of the state in regards to the offplanet geopolitical landscape is reinforced by the practice of usurping NASA as the proprietor of national cultural and technological visions for space. However, the Outer Space treaty maintains that “The activities of non-governmental entities in outer space... shall require authorization and continuing supervision by the appropriate State Party to the Treaty” (United Nations 1967, Article VI). In the U.S., commercial vertical launches have been put under the dictate of the Federal Aviation Administration, an office arguably unprepared for the tasks that had previously been the exclusive prerogative of NASA. NASA argues that access to space will be revolutionized and opened wide via commercial private sector participation contributing to the ISS's benefits for humanity, a very limited understanding of access. By “making space just like any other place to do business...the private sector develops the market, secures the funding, and builds the hardware while the U.S. taxpayer provides the infrastructure” (Rainey 2017). These developments represent profound changes in the role of the state as sole proponent of offplanet activities and therefore reconfigures the previously longstanding position of nation states as the exclusive geopolitical powers in outer space. These shifting relations have implications for future offworld activities, but also guide ground-based development presently, including Spaceport America.

Spaceport America's Launch

A spectacle to see with curvilinear geometry that itself looks like a spacecraft rising out of the desert near Truth or Consequences, New Mexico, Spaceport America conveys a hope of the everyman astronaut (Figure 3). The New Mexico Spaceport Authority's vision is for “Unlocking the potential of space for everyone by offering the world an invitation to space... Enabl[ing] affordable, efficient and effective access to space” (New Mexico Spaceport Authority 2013, 5). Yet this private-public project, the building of which was entirely financed by the taxpayers of New Mexico at a cost of over \$200 million (FAA), has not provided the ease of space transport as a vertical

analog to the airport. Built in anticipation of becoming a major hub of commercial space-based activity, with Virgin Galactic as its anchor tenant, the facility officially opened in 2011. While Virgin Galactic planned to begin commercial spaceflight in 2007, collecting deposits from hundreds of wealthy hopeful astronauts, there have been many setbacks including two fatal private rocketship accidents over the Mojave desert in 2007 and 2014 (Howell 2016). While these tragic launches did not take off from Spaceport America, as commercial passenger flights stall, the spaceport facilities sit largely vacant, dusted off for educational rocketry club launches and Hollywood film back-drops, while most public access to the grounds is restricted.

The Federal Aviation Administration is charged with managing Spaceport America and the other emerging U.S. Spaceports. Taking over the Office of Commercial Space Transportation in 1995, “as the FAA’s only space-related line of business,” in order to “[e]ncourage, facilitate, and promote commercial space launches and reentries by the private sector,” they also must ensure compliance with international obligations. This office provides the soft infrastructure for private spaceflight by regulating and issuing permits for commercial launches of orbital rockets and suborbital rockets, and issuing licenses for non-federal launch sites, like so-called commercial spaceports. The FAA office issued the New Mexico Spaceport Authority its original commercial Space Transportation License in 2008 to operate Spaceport America. This facility is touted as the world’s first purpose-built commercial spaceport, as opposed to other spaceports built as infrastructural extensions of existing airports.

Key to Spaceport America’s vision of commercial space travel is the continued development of competitively priced rocketry systems. In March 2017, Elon Musk’s SpaceX, one of Spaceport America’s two largest leaseholders, made headlines for successfully launching a rocket from Cape Canaveral, Florida and landing it on a drone ship in the Atlantic Ocean using a reusable orbital-class booster. As the most expensive piece of launch systems, the possibility to re-use boosters stands to dramatically decrease the cost of vertical launches. The companies themselves admit, however, that progress toward developing the necessary technology is slow, and indeed neither SpaceX nor Virgin Galactic have actually launched a rocket from Spaceport America’s facilities. Yet, as these technologies continue to evolve, developed by private capital, questions of intellectual property rights have emerged to the forefront of international debate. While U.S. patent law protects inventions “made, used or sold in outer space, on a space object, or component thereof under the jurisdiction or control of the United States” (35 U.S. Code 105), key players in



Figure 3. Spaceport America terminal hangar facility (image source: flickr photo by Barbara Brannon licensed under CC BY 2.0).

the private space sector question the international enforceability of patent laws. Famously, SpaceX has largely rejected the patent system, arguing that “Our primary long-term competition is in China... If we published patents, it would be farcical, because the Chinese would just use them as a recipe book” (Business Insider, Nov. 9 2012). Instead, SpaceX relies on a regime of “trade secrets” protected through internal security procedures, non-disclosure agreements, and non-compete clauses that unlike patents are enforceable indefinitely with the intent to never make designs public.

While private firms increasingly gain control over key technology and infrastructure, their long-term viability is dependent on the emergence of a class of offworld consumers. Virgin Galactic founder, Richard Branson, proclaims his hope is to “create thousands of astronauts over the next few years... [and for] every country in the world to have their own astronauts rather than the privileged few” (September 2004). This anticipatory discourse from the commercial sector’s cultivated imaginary, enticement for the every-man astronaut, is rather different than Congress and NASA’s projection of the everybusiness astromarket—a function of their diverging audiences of citizen taxpayer versus space business mogul. Virgin Galactic is working to build a Future Astronaut global community that they anticipate as a “wonderfully diverse group of pioneering individuals” (Virgin Galactic website), yet requires \$250,000 to be paid as an upfront deposit. As of 2013,

the Future Astronauts club boasts over 600 men, women, and children from more than 50 nations that have bought in.

The spaceport facility is a manifestation of this transitional imaginary away from the publicly-supported space program of the expert astronaut towards publicly-subsidized private ventures, portending an offworld future that reproduces and refines neoliberal relations. As discussed earlier, the image of the everyman astronaut touted by Branson and others has a longer history going back to NASA's shuttle programs. The fusion of Branson's pseudo-egalitarian discourse and NASA's vision of the everyman astronaut are key to securing the dual support needed for the current public-private space model—the transnational class of millionaires and billionaires who stand to become the first space tourists or otherwise stand to benefit from commercial space activity, and the broader, grounded public, whose tax-dollars are needed to support the basic infrastructures needed to make future commercial space enterprises possible.

The Spaceport Between Us

Spaceport America, while consistently missing its financial and launch goals, still maintains some control of its place within the cultural imaginary. As it continues to sit vacant, awaiting the first commercial launches, the facilities have been used as backdrops for music videos, commercials, and Hollywood film productions. While such activities may seem unrelated to the Spaceport America vision, these forms of media indeed help further spread the image of the everyman astronaut and discursively orient the future of public-private space travel.

Spaceport America promotes the first major motion picture filmed at the facility on their website: “The production employed at least 100 New Mexico crew members and approximately 30 New Mexico principal actors and an estimated 1,000 local background talent” (Spaceport America 2016). Spaceport's kickoff film project, *The Space Between Us* (2017), is a romantic teen drama about a boy born on Mars who falls in love with a girl he met via the internet back on Earth. In it, the spaceport is pictured as the headquarters of a private space company that has partnered with NASA to found a colony on Mars. The birth of the main character on Mars is seen as a mistake that is covered up by the company managers, who fear the news would hurt the company's support from NASA and their private investors. The film is littered with discussions of the company's business model.

Yet, the vision of the everyman astronaut touted by the private space sector and NASA, and reproduced in popular media, has not been completely successful in securing public support for Spaceport America. Google reviews of Spaceport America

reveal some public concerns, as Bryan Lindenberger writes: “A great idea at one time, but turned into more tax- payer funded welfare for the wealthy and wired-in. I played a small part in touting it as a huge boon for local economy through tourism, but there’s really not much to see here.” User “Rich Alfano,” writes a one star review, “A huge taxpayer funded boondoggle in the frigging desert! A waste of time and money on a white elephant built for the wealthy,” while another claims “Space Port. The place for rich people only. NO POOR ALLOWED.”

These criticisms have been echoed more broadly across the state as the New Mexico State Auditor found that in 2016 only \$2.2 million of an over \$10 million operating budget was covered by income from commercial lease- holders (NM State NPR, Dec. 8 2017; New Mexico Spaceport Authority 2016). As the facility is not yet self-sufficient, it has relied on “excess funds” from state coffers to cover its daily operating budget. The facility has also drawn criticism for failing to meet public transparency requirements, including refusing requests for public documents and blacking out key information from those documents released (Las Cruces-Sun News, Aug. 23 2017). Indeed, Spaceport managers have asked the New Mexico state legislature to exempt the facility from public records laws with the express intent of offering privacy to their corporate tenants (*El Paso Proud*, Mar. 14, 2017).

While New Mexico residents have criticised the fiscal model and state policies supporting Spaceport America, activists and amateur astronauts elsewhere have focused their attention on proposing alternatives to the public-private model of offworld activity that it represents. The final declaration of the Association of Autonomous Astronauts reads: “On April 23rd 2000, which marks the fifth anniversary of the official launch of our independent space exploration programme, the AAA will spontaneously dissolve itself in order to initiate a new phase of self-historification. We will enter the realm of myth, an inspiration for the Next Generation of space explorers.” Since the spontaneous self-dissolution of AAA in 2000, the Next Generation has indeed arisen.

Space for a Constellation of Actors

The Autonomous Space Association Network (ASAN, NASA’s acronym in reverse), which sees themselves as a direct descendant of AAA’s activities, is “planting the ideological and technical seeds for future space revolutionaries...to let the world know that autonomous space exploration is not only possible, it is imperative.” The network launches high altitude balloons through their Aphrodite Balloon Program and hopes to experiment with open-source rocketry and cubesat technology. In 2017, one ASAN launch made headlines as the “First protest in space” (a claim that

potentially over-looks actions like the 1973 Skylab strike discussed above) for sending a printout of a tweet high into Earth's atmosphere criticizing the Trump administration's reduced funding for NASA's space program (*The Washington Post*, Apr. 14 2017). The message read "@realDonaldTrump: Look at that, you son of a bitch." This was a sentiment taken from astronaut Edgar Mitchell (quoted in Swearingen 2017), describing viewing earth from outer space: "You develop an instant global consciousness, a people orientation, an intense dissatisfaction with the state of the world, and a compulsion to do something about it. From out there on the moon, international politics look so petty. You want to grab a politician by the scruff of the neck and drag him a quarter of a million miles out and say, 'Look at that, you son of a bitch.'"

Other projects ASAN is developing include producing open-source rocket engines, placing a cubesat in orbit by 2020, and creating programs teaching youth how to receive signals from the International Space Station and amateur satellites. ASAN's logic stems from the fact that "everyone is already an astronaut by virtue of existing on this vast spaceship we call 'Earth.' Our members are distressed that the exploration of the cosmos has been entirely monopolized by military actors and, increasingly, private interests." This network of community-based groups do both discursive work and material projects to (re)claim a collective place in space, advancing a mission that is two-fold:

on the one hand, we seek to overturn this government and corporate monopoly on space exploration by raising awareness that everyone is entitled to space and should demand its peaceful exploration. Secondly, ASAN is pursuing the development of open-source technologies so that space exploration becomes a truly global phenomenon in the future, rather than the privilege of a handful of government astronauts (Laika Valentina, ASAN Director General, personal comm. Dec 8, 2017).

As ASAN pursues its goals, it will be able to take advantage of designs, plans, and data from a growing open source space movement.

The notion of "open source" has its origin in the software development sector and is used to describe software whose source code is not subject to private intellectual property regimes, and is thus available to study, edit, modify, and reuse. By allowing open experimentation and decentralized cooperation, the open source development model has spawned constant innovation in software while promoting alternative models of work and ownership (Coleman 2013). In recent years, the successes of the open source software movement has prompted similar activities across hardware development, including the development and production of satellites, rockets and spacecraft (Powell 2012; Simmons, Moran, and Black 2011). ASAN plans to make use

of recent developments in open source Cubesat technology—small satellites weighing between 1 and 10 kilograms that can be easily launched into orbit by “piggybacking” on other launches (Woellert et al. 2011).

Copenhagen Suborbitals may be the most technologically advanced group in the growing open source space movement. Founded in 2008, Copenhagen Suborbitals touts itself as “the world’s only manned amateur space program.” The program relies on crowdfunding, volunteers, and open-source technology and has launched five rockets and space capsules since 2011. The group operates out of a shipyard in Copenhagen, Denmark and launches from a ship in a military firing practice area in the Baltic Sea off the coast of the Danish island of Bornholm. In order to carry out their rocket launches, they negotiate complicated state regulations which limit access to outer space. The group claims to be “the only space organisation that launches rockets from a sailing platform in international waters, since it’s virtually impossible to get permission to do it from the ground in any country” (CopSub website, accessed Dec. 24, 2017). Yet, the group still needs to cooperate with the Danish and Swedish navies and other authorities to ensure the closure of the airspace over their launch sites, access to the firing practice area, and to ensure the launches occur under proper weather conditions. Thus, while the group is autonomous, its activities rely on at least the passive acceptance of national governments, demonstrating that the state is not absent from off-planet activities, but that its main thrust is shifting to facilitation and coordination of such endeavors.

Copenhagen Suborbitals is based around the development, testing, and use of open source technology. They post frequent text and video updates on their blog about the evolution of their designs and their successful and failed experiments with rocketry systems, space capsules, parachutes, space suits, and communication systems, among other technical aspects of their mission— designs and plans that then may be taken and modified by other DIY (Do-It- Yourself) space programs.

Copenhagen Suborbitals’ autonomous, open source, volunteer-based, and crowdfunded model presents a different image of the everyman astronaut than those promoted by NASA or the private space industry. While the group works toward launching their first crewed rocket, they describe who their first astronaut may be:

We’re ordinary guys building a big rocket, so our astronaut should also be an ordinary person. Hiring a professional superhero just wouldn’t match our philosophy (or budget). It should be someone like ourselves, a teacher, engineer, unemployed or housewife with a very, very special dream and balls made of rocket- grade alloy... It will fit with our DIY culture that she or he has been building the rocket herself. (Copenhagen Suborbitals website, accessed Dec. 21, 2017)

While echoing other familiar discourses around the everyman astronaut (and working through some gendering regarding housewives and testicles), coupled with Copenhagen Suborbitals' broader organizational model and relationship to technology, this discourse presents a far more collective understanding of offworld access.

Conclusion

With the shifting role of nation-states in offplanet activity, there are openings for outer space to become another site of capital accumulation and neoliberal relations of domination and exclusion. Yet, there is also potential to manifest outer space as envisioned by social movements such as the Association of Autonomous Astronauts. Connecting the cultural and political dimensions of the "everyman astronaut" with the techno-material infrastructures of Spaceport America and decentralized, communal space programs, demonstrates how the future is rendered present through a spectrum of visions and practices. The actors discussed in this paper are each negotiating various anticipatory futures. The premises set forth in the Outer Space Treaty – outer space exploration and use for the benefit of all – are not guaranteed visions for the future. Congealed in the upward-looking infrastructure of Spaceport America is the material and symbolic rhetoric of publicly funded, private space development, a trajectory that runs from the defunding of NASA's shuttle program through the U.S. Space Act. Autonomous outer space collectives activate radical visions and practices that plug into the technological assemblages of open source rocketry that erode status quo development models emerging for offplanet activities. These competing outer space imaginaries, and multiple others, are vying to reconfigure the political economic, technological, and cultural aspects of offworld access.

Within this field of diverging ideologies and actors, Spaceport America exists in the desert, lacking the private launches it was built for, disappointing public taxpayers, and making its big screen debut in a movie critics call "A sci-fi-tinged heap of sentimentality" (Tribune News Service). However, despite its failings, the performative nature of this infrastructure, and the set of practices that accompany it, represent a daunting inertia, infused with decades of neoliberal doctrine. The building itself, with all its futuristic motif and technological radiance, already seems outdated. The future it stands for seems to harken back to past futures of the 1960s, a popular imagination where everyone drives a flying car. In this sense, as ASAN contends, functionally Spaceport America does not really exist.

...one can only imagine the dismay of the tourists as they traverse this dead facility, a monument to a space-age that will never materialize....Spaceport America points to a reality that has never existed, a reality where spaceports offer uninhibited access to the cosmos for everybody. Arguably, Spaceport America doesn't exist (Laika Valentina, ASAN Director General, personal comm. Dec 8, 2017, emphasis in original).

Instead Spaceport America is neither a spaceport, in that it demonstrates no relation to a public infrastructure in the way that an airport does. Nor is it for America in any broad sense, but instead for the few, super-rich, while being supported by the people of the sixth poorest state in the nation.

Yet, new imaginaries of offworld futures continue to proliferate, while intertwining with persistent political and material relations. Advances in robotic technology have fueled interest in future possibilities for private exploitation of mineral deposits on asteroids, the moon, and other offplanet environments—with the Colorado School of Mines even launching a program in Space Resources in 2018 (NPR, Sept. 25, 2018). In 2017, a bipartisan proposal in the US House of Representatives called for the foundation of a “United States Space Corps” within the US Air Force, while in 2018 the Trump Administration began calling for an entirely new branch of the military known as the “Space Force.” A critical geopolitics of outer space needs to be able to address—and contest—these developments, and indeed geographers are well positioned to do so. Given existing geographical scholarship on questions of human-environment interactions, extractivism, spatio-legal regimes, militarization, social movements, and processes of technological innovation and political economic change, geographers have much to contribute to understanding the shifting contours of offworld access and imagining and enacting alternative futures.

References

- Ansdell, M., P. Ehrenfreund, and C. McKay. 2011. Stepping stones toward global space exploration. *Acta Astronautica* 68 (11):2098–113. doi:10.1016/j.actaastro.2010.10.025.
- Bainbridge, W. S. 2015. *The meaning and value of spaceflight: Public perceptions*. New York, NY: Springer.
- Balli, R. 2003. *Anche Tu Astronauta: Guida all'esplorazione indipendente dello spazio secondo l'Associazione Astronauti Autonomi*. [You Too an Astronaut: A Guide to Independent Space Exploration According to the Association of Autonomous Astronauts]. Rome, Italy: Editore Castelvecchi.
- Battaglia, D. 2012. Arresting hospitality: The case of the “handshake in space”. *Journal of the Royal Anthropological Institute* 18 (Supp S1):S76–S89. doi:10.1111/jrai.2012.18.issue-s1.
- Beery, J. 2012. State, capital, and spaceships: A terrestrial geography of space tourism. *Geoforum* 43:35–34. doi:10.1016/j.geoforum.2011.07.013.

- Beery, J. 2016. Unearthly global natures: Outer space and scalar politics. *Political Geography* 5:92–101. doi:10.1016/j.polgeo.2016.04.003.
- Bensoussan, D. 2010. Space tourism risks: A space insurance perspective. *Acta Astronautica* 66 (11):1633–38. doi:10.1016/j.actaastro.2010.01.009.
- Bould, M., and C. Miéville, editors. 2009. *Red planets: Marxism and science fiction*. Middletown, CT: Wesleyan UP.
- Coleman, G. 2013. Coding freedom: *The ethics and aesthetics of hacking*. Princeton, NJ: Princeton University Press.
- Collis, C. 2009. The geostationary orbit: A critical legal geography of space's most valuable real estate. *The Sociological Review* 57 (1):47–65. doi:10.1111/j.1467-954X.2009.01816.x.
- Compton, W. D., and C. D. Benson. 1983. *Living and working in space: A history of skylab*. Accessed on 24 March 2017. <https://history.nasa.gov/SP-4208/contents.htm>.
- Dickens, P., and J. S. Ormond. 2007. *Cosmic society: Towards a sociology of the universe*. New York, NY: Routledge.
- Dowler, L., and J. Sharp. 2001. A feminist geopolitics? *Space and Polity* 5 (3):165–76. doi:10.1080/13562570120104382.
- Fox, S. J. 2016. SPACE: The race for mineral rights 'the sky is no longer the limit' lessons from Earth! *Resource Policy* 49:165–78. doi:10.1016/j.resourpol.2016.05.001.
- Franco, M. G., and Spideralex. 2014. *Exploración espacial: Una odisea autogestionada. Soberanía Tecnológica*. Barcelona, Spain: Ritmo.
- Geppert, A. C. T. 2012. *Imagining outer space: European astroculture in the twentieth century*. New York, NY: Palgrave Macmillan.
- Glassner, M. I. 1991. The frontiers of earth - and of political geography: The sea, Antarctica and outer space. *Political Geography Quarterly* 10 (4):422–43. doi:10.1016/0260-9827(91)90007-H.
- Goehlich, R. A., J. K. Anderson, N. N. Harrold, J. A. Bemis, M. T. Nettleingham, J. M. Cobin, B. R. Zimmerman, B. L. Avni, M. D. Gonyea, and N. Y. Ilchena. 2013. Pilots for space tourism. *Space Policy* 29 (2):144–53. doi:10.1016/j.spacepol.2013.03.011.
- Harland, D. M., and J. Catchpole. 2002. *Creating the international space station*. Chichester, U.K: Praxis Publishing.
- Hersch, M. H. 2011. Return of the lost spaceman: America's astronauts in popular culture, 1959 – 2006. *The Journal of Popular Culture* 44 (1):73–92. doi:10.1111/j.1540-5931.2010.00820.x.
- Hersch, M. H. 2012. Space madness: The dreaded disease that never was. *Endeavour* 36 (1):32–40. doi:10.1016/j.endeavour.2011.10.001.
- Hitt, D., O. Garriott, and J. Kerwin. 2008. *Homesteading space: The skylab story*. Lincoln, NE: University of Nebraska Press.
- Howell, E. February 17, 2016. Space.com. Accessed December 23, 2017. <https://www.space.com/18993-virgin-galactic.html>.
- Hyndman, J. 2004. Mind the gap: Bridging feminist and political geography through geopolitics. *Political Geography* 23 (3):307–22. doi:10.1016/j.polgeo.2003.12.014.
- Inner City A. A. A. 1998. We have a world to leave behind. *Moving in Several Directions at Once: the Third Annual Report of the Association of Autonomous Astronauts* 36–38.
- Kilgore, D. 2003. *Astrofuturism science, race, and visions of Utopia in space*. Philadelphia, PA: University of Pennsylvania Press.

- Kinsley, S. 2010. Representing 'Things to Come': Feeling the visions of future technologies. *Environment and Planning A* 42 (11):2771–90. doi:10.1068/a42371.
- Klinger, J. M. 2018. *Rare Earth frontiers: From terrestrial subsoils to lunar landscapes*. Ithaca and London: Cornell University Press.
- Lathers, M. 2010. *Space oddities: Women and outer space in popular film and culture, 1960–2000*. New York, NY: Bloomsbury Academic.
- Launius, R. D. 2008. Heroes in a vacuum: The Apollo astronaut as culture icon. *The Florida Historical Quarterly* 87 (2):174–209.
- Levine, A. S. 1982. *Managing NASA in the Apollo Era*. The NASA history series. Washington DC: NASA Scientific and Technological Information Branch.
- Livingston, D. 2003. A code of ethics for conducting business in outer space. *Space Policy* 19 (2):93–94. doi:10.1016/S0265-9646(03)00015-8.
- MacDonald, F. 2007. Anti-astropolitik – Outer space and the orbit of geography. *Progress in Human Geography* 31 (5):592–615. doi:10.1177/0309132507081492.
- Marez, C. 2016. *Farmworker futurism: Speculative technologies of resistance*. Minneapolis, MN: University of Minnesota Press.
- Massaro, V. A., and J. Williams. 2013. Feminist geopolitics. *Geography Compass* 7 (8):567–77. doi:10.1111/gec3.12054.
- Messeri, L. 2016. *Placing outer space: An ethnography of other worlds*. Durham, NC: Duke University Press.
- Naylor, L. 2017. Reframing autonomy in political geography: A feminist geopolitics of autonomous resistance. *Political Geography* 58:24–35. doi:10.1016/j.polgeo.2017.01.001.
- New Mexico Spaceport Authority. 2013. Economic development plan 2013–2018. *New Mexico Legislature*. <https://www.nmlegis.gov/handouts/NMFA%20093013%20Item%2011%20Spaceport%20Authority%20Econ.%20Devel.%20Plan.pdf>
- Olson, V. A. 2012. Political ecology in the extreme: Asteroid activism and the making of an environmental solar system. *Anthropological Quarterly* 85 (4):1027–44. doi:10.1353/anq.2012.0070.
- Ótuathail, G. 1996. An anti-geopolitical eye: Maggie O'kane in Bosnia, 1992–93. *Gender, Place and Culture* 3:171–85. doi:10.1080/09663699650021873.
- Powell, A. 2012. Democratizing production through open source knowledge: From open software to open hardware. *Media, Culture & Society* 34 (6):691–708. doi:10.1177/0163443712449497.
- Rainey, K. 2017. Commercialization of low-earth orbit (LEO). *NASA.gov*, Accessed August 6, 2017: https://www.nasa.gov/mission_pages/station/research/benefits/commercialization_leo.
- Redfield, P. 2000. *Space in the tropics: From convicts to rockets in French Guiana*. Berkeley: University of California Press.
- Sage, D. 2014. *How outer space made America: Geography, organization, and the cosmic sublime*. Burlington, VT: Ashgate Publishing.
- Simmons, J., G. Moran, and J. Black. 2011. A survey of the open source spaceflight movement. *AIAA SPACE 2011 Conference & Exposition*, Long Beach, CA. doi:10.2514/6.2011-7225.
- The Space Between Us*. 2017. Directed by Peter Chelsom. Burbank: STX Entertainment. Spaceport America. Featured news June 7, 2016. Accessed December 6, 2017. <https://spaceportamerica.com/first-major-motion-picture-at-spaceport-america-the-space-between-us/>.

- Swearingen, J. 2017. Mankind can now troll Donald Trump from the heavens. *New York magazine*, April 13. Accessed December 20, 2017. <http://nymag.com/selectall/2017/04/donald-trump-trolled-by-outer-space-tweet.html>.
- Thrift, N. 2004. Remembering the technological unconscious by foregrounding knowledges of position. *Environment and Planning D: Society and Space* 22 (1):175–90. doi:10.1068/d321t.
- United Nations. 1967. *Treaties and principles of outer space*. New York, NY: United Nations.
- Woellert, K., P. Ehrenfreund, A. J. Ricco, and H. Herzfeld. 2011. Cubesats: Cost-effective science and technology platforms for emerging and developing nations. *Advances in Space Research* 47 (4):663–84. doi:10.1016/j.asr.2010.10.009.