# 1NC vs Strake Jesuit Quarters

## 1

### 1nc – t

#### T – Appropriation:

#### Interpretation: Appropriation means use, exploitation, or occupation that is permanent and to the exclusion of others

Babcock 19 Professor of Law, Georgetown University Law Cente. Babcock, Hope M. "The Public Trust Doctrine, Outer Space, and the Global Commons: Time to Call Home ET." Syracuse L. Rev. 69 (2019): 191.

Article II is one of those succeeding provisions that curtails “the freedom of use outlined in Article [I] by declaring that outer space, including the [m]oon and other celestial bodies, is not subject to national appropriation.”147 It flatly prohibits national appropriation of any celestial body in outer space “by means of use or occupation, or by any other means.”148 However, “many types of ‘use’ or ‘exploitation’. . . are inconceivable without appropriation of some degree at least of any materials taken,” like ore or water.149 If this view of Article II’s prohibitory language is correct, then “it is not at all farfetched to say that the OST actually installs a blanket prohibition on many beneficial forms of development.”150 However, the OST only prohibits an appropriation that constitutes a “long-term use and permanent occupation, to the exclusion of all others.”151

#### Violation: Occupation of physical space by debris is not appropriation – temporary denial of use is distinct from property rights, which is the basis of the entire topic

Matignon 19 [Louis de Gouyon Matignon, PhD in space law (co-supervised by both Philippe Delebecque, from Université Paris 1 Panthéon-Sorbonne, France, and Christopher D. Johnson, from Georgetown University, Washington D.C.); "ORBITAL SLOTS AND SPACE CONGESTION." spacelegalissues.com/orbital-slots-and-space-congestion/]

Orbital slots – the “parking spots” of outer space – are allocated to telecom operators via national administrations by the International Telecommunications Union (ITU). There is no cost for an orbital slot, but allocation is on a first-come, first-served basis. If an operator’s competitor files by just a day before them, then they have priority. Although the allocation of a slot does not come with an ownership right to the areas of outer space, it does grant an operator exclusive rights to the resource for the lifetime of its satellite (usually fifteen years). Typically, the operators then keep refiling for the slot and replace old satellites with new ones. So, for all practical purposes, they keep the orbital slot indefinitely.

An orbit is the curved path through which objects in space move around a planet or a star. The 1967 Treaty’s regime and customary law enshrine the principle of non-appropriation and freedom of access to orbital positions. Space Law and International Telecommunication Laws combined to protect this use against any interference. The majority of space-launched objects are satellites that are launched in Earth’s orbit (a very small part of space objects – scientific objects for space exploration – are launched into outer space beyond terrestrial orbits). It is important to precise that an orbit does not exist: satellites describe orbits by obeying the general laws of universal attraction. Depending on the launching techniques and parameters, the orbital trajectory of a satellite may vary. Sun-synchronous satellites fly over a given location constantly at the same time in local civil time: they are used for remote sensing, meteorology or the study of the atmosphere. Geostationary satellites are placed in a very high orbit; they give an impression of immobility because they remain permanently at the same vertical point of a terrestrial point (they are mainly used for telecommunications and television broadcasting).

Geosynchronous orbit (GSO) and geostationary orbit (GEO) are orbits around Earth at an altitude of 35 786 kilometres matching Earth’s sidereal rotation period. All geosynchronous and geostationary orbits have a semi-major axis of 42 164 kilometres. A geostationary orbit stays exactly above the equator, whereas a geosynchronous orbit may swing north and south to cover more of the Earth’s surface. Communications satellites and weather satellites are often placed in geostationary orbits, so that the satellite antennae (located on Earth) that communicate with them do not have to rotate to track them, but can be pointed permanently at the position in the sky where the satellites are located.

Near-Earth space is formed of different orbital layers. Terrestrial orbits are limited common resources and inherently repugnant to any appropriation: they are not property in the sense of law. Orbits and frequencies are res communis (a Latin term derived from Roman law that preceded today’s concepts of the commons and common heritage of mankind; it has relevance in international law and common law). It’s the first-come, first-served principle that applies to orbital positioning, which without any formal acquisition of sovereignty, records a promptness behaviour to which it grants an exclusive grabbing effect of the space concerned. Geostationary orbit is a limited but permanent resource: this de facto appropriation by the first-comers – the developed countries – of the orbit and the frequencies is protected by Space Law and the International Telecommunications Law. The challenge by developing countries of grabbing these resources is therefore unjustified on the basis of existing law. Denying new entrants geostationary-access or making access more difficult does not constitute appropriation; it simply results from the traditional system of distribution of access rights. The practice of developed States is based on free access and priority given to the first satellites placed in geostationary orbit.

#### 1] Precision – if we win definitions the aff doesn’t defend a shift from the squo or solve their advantages – so at best vote negative on presumption. The resolution is the only predictable stasis point for dividing ground—any deviation justifies the aff arbitrarily jettisoning words in the resolution at their whim which decks negative ground and preparation because the aff is no longer bounded by the resolution.

#### 2] Predictable limits—including satellite slots offers huge explosion in the topic since they get permutations of different satellite systems – LEO MEO and HEO, plus different companies, plus sizes of constellations, et cetera. Letting temporary occupation be appropriation is a limits diaster - any aff about a single space ship, satellite, or weapon would be T because they temporarily occupy space. Limits explodes neg prep burden and draws un-reciprocal lines of debate, where the aff is always ahead, turns their pragmatics offense

#### Topicality is a voting issue that should be evaluated through competing interpretations – it tells the negative what they do and do not have to prepare for—there’s no way for the negative to know what constitutes a “reasonable interpretation” when we do prep – reasonability is arbitrary and causes a race to the bottom, proliferating abuse

#### No RVIs—it’s your burden to be topical and RVIs bait theory which kills substance education – tubes the only portable impact to debate

## 2

### 1nc – t

#### Interpretation: the aff cannot specify a type of space appropriation

#### Bare plurals imply a generic “rules reading” in the context of moral statements

Cohen 1 — (Ariel Cohen, Professor of Linguistics @ Ben-Gurion University of the Negev, PhD Computational Linguistics from Carnegie Mellon University, “On the Generic Use of Indefinite Singulars”. Journal of Semantics 18: 183-209, Oxford University Press, 2001, accessed 12-7-20, HKR-AM) \*\*BP = bare plurals

According to the rules and regulations view, on the other hand, generic sentences do not get their truth or falsity as a consequence of properties of individual instances. Instead, generic sentences are evaluated with regard to rules and regulations, which are basic, irreducible entities in the world. Each generic sentence denotes a rule; if the rule is in effect, in some sense (different theories suggest different characterizations of what it means for a rule to be in effect), the sentence is true, otherwise it is false. The rule may be physical, biological, social, moral, etc. The paradigmatic cases for which this view seems readily applicable are sentences that refer to conventions, i.e. man-made, explicit rules and regulations, such as the following example (Carlson 1995: 225):

(40) Bishops move diagonally.

Carlson describes the two approaches as a dichotomy: one has to choose one or the other, but not both. One way to decide which approach to choose is to consider a case where the behavior of observed instances conflicts with an explicit rule. Indeed, Carlson discusses just such a case. He describes a supermarket where bananas sell for $0.49/lb, so that (41a) is true. One day, the manager decides to raise the price to $1.00/lb. Immediately after the price has changed, claims Carlson, sentence (41a) becomes false and sentence (41b) becomes true, although the overwhelming majority of sold bananas were sold for $0.49/lb.

(41) a. Bananas sell for $0.49/lb.

b. Bananas sell for $1.00/lb.

Consequently, Carlson reaches the conclusion that the rules and regulations approach is the correct one, whereas the inductivist view is wrong.

While I share Carlson’s judgements, I do not accept the conclusion he draws from them. Suppose the price has, indeed, changed, but the supermarket employs incompetent cashiers who consistently use the old price by mistake, so that customers are still charged $0.49/lb. In this case, I think there is a reading of (41a) which is true, and a reading of (41b) which is false. These readings are more salient if the sentence is modified by expressions such as actually or in fact:

(42) a. Bananas actually sell for $0.49/lb.

b. In fact, bananas sell for $1.00/lb.

BP generics, I claim, are ambiguous: on one reading they express a descriptive generalization, stating the way things are. Under the other reading, they carry a normative force, and require that things be a certain way. When they are used in the former sense, they should be analysed by some sort of inductivist account; when they are used in the latter sense, they ought to be analysed as referring to a rule or a regulation. The respective logical forms of the two readings are different; whereas the former reading involves, in some form or another, quantification, the latter has a simple predicate-argument structure: the argument is the rule or regulation, and the predicate holds of it just in case the rule is ‘in effect’.

#### Violation—they specified antitrust

#### Vote neg for predictable limits—specifying a type of appropriation offers a huge explosion in the topic since they get permutations of hundreds of appropriations. Limits explodes neg prep burden and draws un-reciprocal lines of debate, where the aff is always ahead.

## 3

### 1nc – k

#### Settler colonialism is the ontological permeating structure of the nation-state which requires the elimination of indigenous life and land via the occupation of settlers. The appropriation of land turns Natives into ghosts and chattel slaves into excess labor.

Tuck and Yang 12

(Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40, JKS)

Our intention in this descriptive exercise is not be exhaustive, or even inarguable; instead, we wish to emphasize that (a) decolonization will take a different shape in each of these contexts - though they can overlap - and that (b) neither external nor internal colonialism adequately describe the form of colonialism which operates in the United States or other nation-states in which the colonizer comes to stay. Settler colonialism operates through internal/external colonial modes simultaneously because there is no spatial separation between metropole and colony. For example, in the United States, many Indigenous peoples have been forcibly removed from their homelands onto reservations, indentured, and abducted into state custody, signaling the form of colonization as simultaneously internal (via boarding schools and other biopolitical modes of control) and external (via uranium mining on Indigenous land in the US Southwest and oil extraction on Indigenous land in Alaska) with a frontier (the US military still nicknames all enemy territory “Indian Country”). The horizons of the settler colonial nation-state are total and require a mode of total appropriation of Indigenous life and land, rather than the selective expropriation of profit-producing fragments. Settler colonialism is different from other forms of colonialism in that settlers come with the intention of making a new home on the land, a homemaking that insists on settler sovereignty over all things in their new domain. Thus, relying solely on postcolonial literatures or theories of coloniality that ignore settler colonialism will not help to envision the shape that decolonization must take in settler colonial contexts. Within settler colonialism, the most important concern is land/water/air/subterranean earth (land, for shorthand, in this article.) Land is what is most valuable, contested, required. This is both because the settlers make Indigenous land their new home and source of capital, and also because the disruption of Indigenous relationships to land represents a profound epistemic, ontological, cosmological violence. This violence is not temporally contained in the arrival of the settler but is reasserted each day of occupation. This is why Patrick Wolfe (1999) emphasizes that settler colonialism is a structure and not an event. In the process of settler colonialism, land is remade into property and human relationships to land are restricted to the relationship of the owner to his property. Epistemological, ontological, and cosmological relationships to land are interred, indeed made pre-modern and backward. Made savage. In order for the settlers to make a place their home, they must destroy and disappear the Indigenous peoples that live there. Indigenous peoples are those who have creation stories, not colonization stories, about how we/they came to be in a particular place - indeed how we/they came to be a place. Our/their relationships to land comprise our/their epistemologies, ontologies, and cosmologies. For the settlers, Indigenous peoples are in the way and, in the destruction of Indigenous peoples, Indigenous communities, and over time and through law and policy, Indigenous peoples’ claims to land under settler regimes, land is recast as property and as a resource. Indigenous peoples must be erased, must be made into ghosts (Tuck and Ree, forthcoming). At the same time, settler colonialism involves the subjugation and forced labor of chattel slaves, whose bodies and lives become the property, and who are kept landless. Slavery in settler colonial contexts is distinct from other forms of indenture whereby excess labor is extracted from persons. First, chattels are commodities of labor and therefore it is the slave’s person that is the excess. Second, unlike workers who may aspire to own land, the slave’s very presence on the land is already an excess that must be dis-located. Thus, the slave is a desirable commodity but the person underneath is imprisonable, punishable, and murderable. The violence of keeping/killing the chattel slave makes them deathlike monsters in the settler imagination; they are reconfigured/disfigured as the threat, the razor’s edge of safety and terror. The settler, if known by his actions and how he justifies them, sees himself as holding dominion over the earth and its flora and fauna, as the anthropocentric normal, and as more developed, more human, more deserving than other groups or species. The settler is making a new "home" and that home is rooted in a homesteading worldview where the wild land and wild people were made for his benefit. He can only make his identity as a settler by making the land produce, and produce excessively, because "civilization" is defined as production in excess of the "natural" world (i.e. in excess of the sustainable production already present in the Indigenous world). In order for excess production, he needs excess labor, which he cannot provide himself. The chattel slave serves as that excess labor, labor that can never be paid because payment would have to be in the form of property (land). The settler's wealth is land, or a fungible version of it, and so payment for labor is impossible.6 The settler positions himself as both superior and normal; the settler is natural, whereas the Indigenous inhabitant and the chattel slave are unnatural, even supernatural. Settlers are not immigrants. Immigrants are beholden to the Indigenous laws and epistemologies of the lands they migrate to. Settlers become the law, supplanting Indigenous laws and epistemologies. Therefore, settler nations are not immigrant nations (See also A.J. Barker, 2009). Not unique, the United States, as a settler colonial nation-state, also operates as an empire - utilizing external forms and internal forms of colonization simultaneous to the settler colonial project. This means, and this is perplexing to some, that dispossessed people are brought onto seized Indigenous land through other colonial projects. Other colonial projects include enslavement, as discussed, but also military recruitment, low-wage and high-wage labor recruitment (such as agricultural workers and overseas-trained engineers), and displacement/migration (such as the coerced immigration from nations torn by U.S. wars or devastated by U.S. economic policy). In this set of settler colonial relations, colonial subjects who are displaced by external colonialism, as well as racialized and minoritized by internal colonialism, still occupy and settle stolen Indigenous land. Settlers are diverse, not just of white European descent, and include people of color, even from other colonial contexts. This tightly wound set of conditions and racialized, globalized relations exponentially complicates what is meant by decolonization, and by solidarity, against settler colonial forces. Decolonization in exploitative colonial situations could involve the seizing of imperial wealth by the postcolonial subject. In settler colonial situations, seizing imperial wealth is inextricably tied to settlement and re-invasion. Likewise, the promise of integration and civil rights is predicated on securing a share of a settler-appropriated wealth (as well as expropriated ‘third-world’ wealth). Decolonization in a settler context is fraught because empire, settlement, and internal colony have no spatial separation. Each of these features of settler colonialism in the US context - empire, settlement, and internal colony - make it a site of contradictory decolonial desires7. Decolonization as metaphor allows people to equivocate these contradictory decolonial desires because it turns decolonization into an empty signifier to be filled by any track towards liberation. In reality, the tracks walk all over land/people in settler contexts. Though the details are not fixed or agreed upon, in our view, decolonization in the settler colonial context must involve the repatriation of land simultaneous to the recognition of how land and relations to land have always already been differently understood and enacted; that is, all of the land, and not just symbolically. This is precisely why decolonization is necessarily unsettling, especially across lines of solidarity. “Decolonization never takes place unnoticed” (Fanon, 1963, p. 36). Settler colonialism and its decolonization implicates and unsettles everyone.

#### Debris cooperation assumes a globalized view of space where debris is treated as an isolated object that impacts all equally---this view assumes equal access under a common property approach that attempts to divorce Earthly power relations from space

Phillip A. Slann 15, Ph.D. Candidate in International Relations at Keele University, March 2015, “The security of the European Union’s critical outer space infrastructures,” http://eprints.keele.ac.uk/522/1/Slann%20PhD%202015.pdf

The astropolitical literature advocating cooperative approaches to outer space affairs take a wider, globalised view of near-Earth space. They portray the domain as one of mutual vulnerability, where seemingly isolated activities can rapidly have a wideranging impact (see Johnson-Freese, 2007; Moltz, 2008: 46). Debris generated through the destruction of a space object is indiscriminate with regards to the ownership of satellites.

As Johnson-Freese (2007) notes, “if a [US] space weapon were used in space, it would create a debris cloud most dangerous to other U.S. space assets. Consequently, the United States gains nothing by having space weapons and potentially loses the most by using them” (p. 134). The promotion of cooperation through regime-based governance as means to resolve disputes and encourage sustainability conceptualises near-Earth space as a commons, where actors maintain the right to equal access to the domain and resources are either available to all or managed under a common property resource approach (Vogler, 2000; Weeden and Chow, 2012). In astrographical and astropolitical terms, the advocacy of inter-actor cooperation, regardless of whether it is supported by legal regimes and TCBMs, involves a conceptualisation of near-Earth space as relatively distinct from terrestrial affairs. While the terrestrial impacts of outer space activities remain important, extra-terrestrial governance is depicted as largely divorced from the political power relations on Earth.

#### Thus, the only alternative is decolonization. The ROB is to center indigenous scholarship and resistance – any ethical commitment requires that the aff places itself in the center of native scholarship and demands.

Tuck and Yang 12

(Eve Tuck, Unangax, State University of New York at New Paltz K. Wayne Yang University of California, San Diego, Decolonization is not a metaphor, Decolonization: Indigeneity, Education & Society Vol. 1, No. 1, 2012, pp. 1-40, JKS)

An ethic of incommensurability, which guides moves that unsettle innocence, stands in contrast to aims of reconciliation, which motivate settler moves to innocence. Reconciliation is about rescuing settler normalcy, about rescuing a settler future. Reconciliation is concerned with questions of what will decolonization look like? What will happen after abolition? What will be the consequences of decolonization for the settler? Incommensurability acknowledges that these questions need not, and perhaps cannot, be answered in order for decolonization to exist as a framework. We want to say, first, that decolonization is not obliged to answer those questions - decolonization is not accountable to settlers, or settler futurity. Decolonization is accountable to Indigenous sovereignty and futurity. Still, we acknowledge the questions of those wary participants in Occupy Oakland and other settlers who want to know what decolonization will require of them. The answers are not fully in view and can’t be as long as decolonization remains punctuated by metaphor. The answers will not emerge from friendly understanding, and indeed require a dangerous understanding of uncommonality that un-coalesces coalition politics - moves that may feel very unfriendly. But we will find out the answers as we get there, “in the exact measure that we can discern the movements which give [decolonization] historical form and content” (Fanon, 1963, p. 36). To fully enact an ethic of incommensurability means relinquishing settler futurity, abandoning the hope that settlers may one day be commensurable to Native peoples. It means removing the asterisks, periods, commas, apostrophes, the whereas’s, buts, and conditional clauses that punctuate decolonization and underwrite settler innocence. The Native futures, the lives to be lived once the settler nation is gone - these are the unwritten possibilities made possible by an ethic of incommensurability.*when you take away the punctuation he says of lines lifted from the documents about military-occupied land its acreage and location you take away its finality opening the possibility of other futures* -Craig Santos Perez, Chamoru scholar and poet (as quoted by Voeltz, 2012)

Decolonization offers a different perspective to human and civil rights based approaches to justice, an unsettling one, rather than a complementary one. Decolonization is not an “and”. It is an elsewhere.

#### Our interpretation is that the judge ought to evaluate the aff as a research project – they don’t get to weigh the material implementation of the case

#### 1. Plan focus restricts the debate to a ten second statement and leaves the rest of the aff unquestioned. They should be responsible for the way their knowledge is constructed and used because that produces the best model for activism and ethics in the context of their aff

#### 2. The K is a prior question – it informs the value of the game – if we win debate trains students to be violent outside of their rounds, that should come first and it impact turns the education from their model

#### 3. Debate is a site of scholarship production, not policymaking 101. Even if individual ballots do not change our subjectivities, iterative investments in research models influence our political orientations. Rejecting paradigms premised on settler colonial in pedagogical spaces can act as a starting point for a decolonized vision of politics

## 4

### 1nc – da

#### **Emerging appropriation is driving global growth and stock values**

Willard 19 [Cody Willard is the editor of TradingWithCody.com where he posts all his stock and option trades from his personal account. He also runs a hedge fund. "The Space Revolution Will Become The Biggest Industry In The History Of Our Planet." https://seekingalpha.com/article/4311147-space-revolution-will-become-biggest-industry-in-history-of-planet]

The tectonic plates of our society, economies and culture have shifted to a place where for the first time in the history of our planet, private companies will be in a Space Race. Think about that — for all the world’s riches, there are many more times the amount wealth to be had in outer space. Up until the last decade or so, only the richest governments in the world could possibly consider space travel. Fast forward to today and a private space company (SpaceX) (SPACE) has made NASA look silly and stuck in the mud. In another five years, people will be paying money to travel on space ships from private companies to space colonies on space stations, the moon and Mars — all funded from private companies.

In fact, there are dozens of private startups looking to blast us into the Space Revolution, starting with the most obvious and biggest ones like Blue Origin (BORGN) and SpaceX on down to companies like Relativity Space, which is founded by a bunch of former individuals from SpaceX and Blue Origin. Relativity is planning to use 3D printing technology to manufacture rocket ships at a fraction of the cost of current designs and processes.

I’d mentioned in the most recent quarterly investor update that I send to my hedge fund partners the following:

“There are trillions of dollars moving every day in this economic world and some of these trends are building to places that are about to become obvious trillion-dollar industries. The biggest opportunity of all that’s just now burgeoning into what might become perhaps the single largest industry in our economy over the next three to five decades — the Space Revolution.

The best publicly-traded play on the Space Revolution is Boeing (BA), which I’ve started building a position in already because I like the duopoly status of its airplane business anyway. But as you also know that we also have the ability to invest in some non-publicly-traded companies using Republic and other platforms.”

Cody back in real-time September 17, 2020.

Some of the leading companies in the Space Revolution will be coming public in the next few years and I’ll be on top of every single trend, revenue model and idea that will be creating the biggest industry in the history of our planet. Yes, I said it, the Space Revolution will be the biggest industry in the history of our planet.

The Space Revolution will create many trillions of dollars of new markets as we populate the skies with ever-more functional satellites (think speeds 100x that of 5G for $20 a month available anywhere, anytime for billions of customers), and then we’ll start creating privately-funded/owned colonies on privately-funded/owned space station societies and on the moon and on Mars. And we’ll be mining precious metals and (heretofore) rare (Earth) minerals on asteroids and harnessing the energy of comets and sending unmanned space drones to mine the outer reaches of the galaxy... I’m not exaggerating. But I'm talking about decades ahead, not the next few years for most of this stuff.

Remember back in 2009-2011 when I used to predict so endlessly with so much confidence that the Smartphone Revolution would create trillion-dollar industries and that we needed to invest heavily in it? And I’ve often noted that we’ll find amazing revolutionary companies coming public as each revolution gets into second and third gear. That’s exactly what’s about to happen with the Space Revolution. This isn’t about investing in a company here and there today. It’s about getting our ducks in a row as we prepare for the largest industry in the history of the planet to take off.

I’m as confident that the Space Revolution will create the easiest and most obvious next trillion-dollar opportunities as I’ve ever been about any Revolution Investment theme I’ve positioned us for. More confident, in fact. Beam me up, Scotty, because space is truly the final frontier of our planet’s economy.

#### Perception of declining returns causes price crashes that bankrupts commercial tech.

Anderson 22 – Maia, “SPAC deals promised a golden ticket for a host of upstart space companies. Now the bubble's bursting — and their established rivals are surging.” 03/21/2022, https://www.businessinsider.com/space-spac-stock-prices-virgin-galactic-planet-labs-2022-3

The SPAC route to the public market has been especially popular in this industry not because the companies necessarily want to be public but because they need lots of capital, said Simon Potter, head of investment and financial consulting at the industry research firm BryceTech. Space companies often need hundreds of millions, if not billions, of dollars to make their business models work. SPAC deals let them raise capital a lot faster and with a lot less effort than initial public offerings.

And when one company lands a lucrative deal, it creates an incentive for its competitors to do the same.

"The SPAC phenomenon has essentially set off an arms race in the industry," Chris Quilty, founder and partner at the boutique space advisory Quilty Analytics, told Insider. "Companies that fail to raise capital, whether through SPAC or some other means, are going to find themselves at a disadvantage to competitors that have raised large pools of money."

The number of companies announcing SPAC deals started to slow in the second half of 2021, when the US Securities and Exchange Commission started looking into the craze, seeking information on how banks manage the deals' risks and the values of target companies. But the trend isn't quite dead: Just this week, the satellite company SatixFy announced plans to go public through a merger with Endurance Acquisition Corp.

Why space SPAC stocks are nose-diving

The SPAC downturn isn't unique to the space industry. Electric-vehicle startups, for example, hit a wave of trouble last year. With interest rates expected to go up multiple times this year in an attempt to fight inflation, the market outlook is souring for SPAC deals.

"For now, at least, the enthusiasm has waned," Potter said. "The experience that this 2021 cohort of companies is currently having will understandably inform future decision-making."

But one reason space SPAC stocks, in particular, haven't been faring well is that many space companies outlined very aggressive targets when they went public. There's a "fairly well understood phenomenon" of SPAC companies, not just in the space sector, providing much more aggressive growth forecasts than would be allowed under an IPO, according to Quilty. Many SPACs — across all sectors — have had to lower their guidance since going public, which has a predictable impact on their stock prices.

The market also tends to group space companies together into one category rather than look at their individual performances, Potter told Insider, so the widespread trend of stocks falling has less to do with each individual company's operations than a generalized sentiment toward the industry.

"Any perception in the market that those targets may not be achievable is going to be reflected in a daily share price," Potter said. Public companies are under pressure to deliver. "Underperformance is going to get punished."

#### Uncertainly means debris regulations would go too far in the name of uncertainty – operators would have to move every time there could potentially be a collision – result is massive operator expenses

Atherton 20 Atherton, Kelsey. Kelsey Atherton blogs about military technology for C4ISRNET, Fifth Domain, Defense News, and Military Times. He previously wrote for Popular Science, and also created, solicited, and edited content for a group blog on political science fiction and international security. "Space debris collisions can be disastrous. How can we reduce the risk?" C4ISRNet, Feb 10, 2020, www.c4isrnet.com/r/c2-comms/satellites/2021/11/18/space-debris-calculating-orbital-collision-risk.

The authors contend that existing formulas used to estimate risk and uncertainty in orbit are unable to positively identify safe passage. By relying on these formulas, then, the entire space industry risks collisions that could scatter debris throughout orbit, threatening satellites and the entire utility of space. “Here is the standard my co-authors and I advocate for each and every conjunction: Prove to me this conjunction will not result in a collision,” said Balch. In other words, instead of moving when there’s a chance of a collision, operators would have to move to safety unless they could prove there would not be a crash. If the authors are right, theoretically, satellite operators would have to move objects in orbit every time they could not conclusively prove that there was no risk of collision. And that is an expensive change. Contrast it with a standard that requires evasive action only if available evidence suggests a collision is otherwise unavoidable. The method proposed by Balch, et al, treats every possible conjunction as a game of chicken played by inanimate objects that will never blink and change course on their own — an inevitable collision unless action is taken. “Those driving new space ventures seriously misunderstand the challenges with tracking objects in orbit today. Many assume that some governmental body (e.g., the U.S. government) has this all under control and knows exactly what is in orbit, where it is located, and tracks everything continuously,” wrote T.S. Kelso in an email. Kelso is the operations manager for the Space Data Center, which daily screens hundreds of objects in orbit for the risk of collision. “That could not be further from the truth. Making these assumptions can (and does) lead to making bad decisions about methodologies to apply to mitigating risk.”

#### Commercial space solves extinction

Beames ’18 [Charles; July; Chairman of the SmallSat Alliance, Executive Chairman of York Space Systems, former Principal Director of Space and Intelligence in the Office of the Undersecretary of Defense for Acquisition, Technology, and Logistics (OUSD(AT&L)), active early stage investor in entrepreneurial space, former President of Vulcan Aerospace where he was responsible for asset allocation within a privately held aerospace investment portfolio exceeding $1B, Col. (ret.) in the USAF where he served 23 years in space & intelligence leadership positions around the world; SpaceNews Magazine, [https://spacenews.com/op-ed-smallsat-alliance-is-on-a-path-toward-a-new-space-horizon]](https://spacenews.com/op-ed-smallsat-alliance-is-on-a-path-toward-a-new-space-horizon%5d)

A wonderful outgrowth of the legacy space program is the commercial, entrepreneurial, and job-creating commercial space business that it bequeathed. These next-generation enterprises range from multi-million-dollar startups providing rideshare opportunities or components for small satellites to multi-billion-dollar space data-analytic platforms reinventing urban car service and agricultural production. The early returns of this economic revolution are already on our doorstep: space data capabilities are exponentially growing elements of the 21st century world economy.

Beginning with the dreams and funding by successful tech entrepreneurs, enormous venture investments are already delivering wondrous benefits to the world.

Commercial Space – Profit and Non-Profit

There are really two major categories in the commercial sector, the profit driven and the non-profit. The classic for-profit companies include not only those designing, building, launching, and operating satellites but also the tech sector that is turning that raw space data into gold through machine-learning analytics. Since for-profit companies are no longer dependent upon the revenues generated by the Cold War space race culture of a bygone era, this new generation of space companies is able to more efficiently capitalize on Moore’s Law, the nonstop exponential growth in chip density, and the associated networking technology co-evolving with it. This new generation is building profitable businesses helping to clean up our oceans of garbage and debris with satellite surveillance, reconnoitering to assist in enforcing laws that protect our oceans from illegal, unregulated, unlicensed fishing, something that is rapidly depleting the world’s most valuable and essential lifeforms. It’s leading in the innovative use of low-cost satellite constellations to produce ubiquitous remote-sensing data, enabling small business owners to be more profitable and less wasteful. For example, precise timing signals from space are already optimizing transportation of people, goods, and services, with even further gains anticipated with the introduction of artificial intelligence to assist drivers, perhaps even someday replacing them entirely.

The non-profit sector is the other side of commercial space, concerned more for the general welfare of society, but every bit as integral to this new space enterprise. Much like every century before it in human history, ours is not without its unique challenges, some of which have been a consequence of the last, and all of which the space data domain can be leveraged to help solve. Examples are endless, but one challenge that this new space community is uniquely well-adapted for is to further inform worldwide resource allocation for the 21st century and beyond. These two primary resources are sustainable water and the materials needed for adequate housing for an ever-increasing human population. As cities and urbanization continue to expand, governmental planning challenges such as transportation design optimization for goods and services are only the beginning. Additionally, through using inexpensive remote sensing technologies, some members are designing space data analytics to mitigate human suffering from plagues, contain outbreaks, and combating illegal poaching. Some are connecting with other non-profits to curtail human trafficking for the sex trade or forced labor for migrant debt repayment. Still others are helping non-governmental organizations in their work to expose the use of children as soldiers. Addressing these challenges has little to do with resuscitating dreams conceived by long deceased science-fiction writers and much more to do with turning “swords back into plowshares” to solve real threats to humanity.

Other non-profit initiatives include pursuing an even more foundational understanding of who we are and how to be the best custodians of our environment. Much as exploring and monitoring the world’s oceans has advanced civilization through a better understanding of human life and the planet, so too does exploring and monitoring from space. Low Earth orbit (LEO) provides a unique vantage point to look back on the planet and understand what is happening, anticipate what might happen and prepare for the future. In addition to better understanding Earth, responsible and rapid exploitation of the low Earth orbit domain will enhance the understanding of the solar system and the rest of the universe. Small satellites already offer low-cost platforms to study and explore what lies beyond the Earth. Other members are pioneering the use of zero-carbon, hydrogen-based reusable propulsion systems to ensure we don’t worsen our atmosphere using kerosene-fueled rockets for the coming tsunami of satellite launches. Finally, a mission ensuring the general welfare and planet survival for the next thousand years is finally confronting the existential threat that asteroids and comets pose to humanity. These extra-terrestrial, deep-space threats are passing dangerously close to our planet, and today we have no solar map of them and no defense.

## 5

### 1nc – cp

#### States should:

#### Remove the most volatile and largest Debris pieces from the most congested orbits

#### Mandate UN guidelines on space debris mitigation

#### Collaborate on techniques to track and display the location of objects in real time and AI to automate debris-avoidance maneuvers

#### increase funding for space-situational awareness technology, and

#### warn all states about known impending collisions on their space assets.

#### That solves satellites, miscalc, Kessler, and debris collisions

Nature 8/11 [(Nature Editorial Board, peer-reviewed, comprises experimental scientists and data-standards experts from across different fields of science) “The world must cooperate to avoid a catastrophic space collision,” Nature, 8/11/2021] JL

But there are no traffic cops in space, nor international borders with clearly delineated areas of responsibility. To avoid further damage, it’s crucial that satellite operators have an accurate and up-to-date list of where objects are in space. At present, the main global catalogue of space objects is published at Space-Track.org by the US Space Command, a branch of the military. The catalogue is the most widely used public listing available, but it lacks some satellites that countries — including the United States, China and Russia — have not acknowledged publicly. In part because of this lack of transparency, other nations also track space objects, and some private companies maintain commercially available catalogues.

Rather than this patchwork of incomplete sources, what the world needs is a unified system of space traffic management. Through this, spacefaring nations and companies could agree to share more of their tracking data and cooperate to make space safer. This might require the creation of a new global regime, such as an international convention, through which rules and technical standards could be organized. One analogy is the International Telecommunication Union, the United Nations agency that coordinates global telecommunications issues such as who can transmit in which parts of the radio spectrum.

It won’t be easy to create such a system for space traffic. For it to succeed, questions of safety (such as avoiding smashing up a satellite) will need to be disentangled from questions of security (such as whether that satellite is spying on another nation) so that countries can be assured that participating in such an effort would not compromise national security. Countries could, for instance, share information about the location of a satellite without sharing details of its capabilities or purpose for being in space.

One near-term move that would help would be for the United States to complete a planned shift of responsibility for the Space-Track.org catalogue from the military to the civilian Department of Commerce. Because this catalogue has historically been the most widely used around the world, shifting it to a civilian agency could start to defuse geopolitical tensions and so improve global efforts to manage space debris. It might one day feed into a global space-traffic agreement between nations; even the nascent space superpower China would have a big incentive to participate, despite rivalries with the United States. The transition was called for in a 2018 US presidential directive that recognizes that companies are taking over from national governments as the dominant players in space, but it has yet to occur, in part because Congress has not allocated the necessary funds.

On 25 August, the UN Committee on the Peaceful Uses of Outer Space will meet to discuss a range of topics related to international cooperation in space. The UN is the right forum through which spacefaring nations can work together to establish norms for responsible space behaviour, and that should include how the world can track objects to make space safer. It should continue recent work it has been doing emphasizing space as a secure and sustainable environment, which at least brings countries such as the United States and China into the same conversation.

Basic research has a role, too: innovations such as techniques to track and display the locations of orbiting objects in real time, and artificial intelligence to help automate debris-avoidance manoeuvres, could bolster any global effort to monitor and regulate space.

If governments and companies around the world do not take urgent action to work together to make space safer, they will one day face a catastrophic collision that knocks out one or more satellites key to their safety, economic well-being or both. Space is a global commons and a global resource. A global organization responsible for — and capable of — managing the flow of space traffic is long overdue.

#### Removing the largest debris and implementing UN mandates solves – lack of clarity is the problem

Khlystov 18 [Nikolai Khlystov](https://www.weforum.org/agenda/authors/nikolai-khlystov) Lead, Space, and lead, Global Future Council on Space, World Economic Forum. 3 April, 2018 “We have a space debris problem Here’s how to solve it” [We have a space debris problem. Here’s how to solve it | World Economic Forum (weforum.org)](https://www.weforum.org/agenda/2018/04/we-have-a-space-debris-problem-heres-how-to-solve-it/) Accessed 12-19 // gord0

The first Chinese space station, Tiangong-1, crashed on 1 April over the Southern Pacific, after uncontrollably re-entering the Earth’s atmosphere.

In fact, the station most likely all but burned up on re-entry, ironically very close to the location called ‘spacecraft cemetery’, where space agencies purposefully guide their old spacecraft to crash as it is the most isolated location in the ocean.

The Chinese authorities lost contact with the station back in 2016 and could not guide it since then.

Tiangong-1 is one example of space debris that ended up coming back to Earth and burning up, just like most other debris that re-enters Earth’s atmosphere. That is not a bad thing.

But large quantities of space junk end up staying in various orbits around Earth, threatening satellites, the International Space Station (ISS), as well as future missions beyond Earth's vicinity – to asteroids, the Moon and Mars.

Somewhat similar to pieces of tyres that litter the highways on Earth, debris can be parts of old satellites, from paint chips, to bolts, larger sections, and entire defunct satellites; it can also include spent rocket bodies, the sections of rockets that don’t fall back to Earth after a rocket's launch. The total number of debris pieces larger than a marble counts more than half a million.

[photo omitted]

The key difference is that while it would be dangerous for your car to hit a piece of garbage on the highway at 100 km/h, in orbit, things are moving at the much faster speed of 28,000 km/h – the speed required by the laws of physics for objects to stay in orbit and not fall back to the ground.

At that speed, even a small bolt could destroy an entire satellite, or even endanger the entire Space Station. That is the reason why astronauts or cosmonauts on board the ISS have to huddle into the escape capsules several times a year, when a piece of debris is being tracked close to the Space Station. Currently only the Russian Soyuz offers a way of getting to and from the ISS for humans.

The most polluted orbits in general are considered to be those between 200-2000 km above Earth (Lower Earth Orbits or LEO), and the 36,000 km orbit (Geosynchronous).

This is a growing issue, which has become more widely known to the public through the movie ‘Gravity’.

Out-of-control space junk in LEO orbit – the so-called Kessler Syndrome – in real life would not be quite as dramatic as in the movie; however, it does pose a serious and an ever-growing threat, nonetheless.

There are two key elements to addressing this global risk.

First, we need to start removing the most volatile and biggest pieces from the most congested orbits.

A number of companies, such as Astroscale and Saber Astronautics, are looking at this very complicated and technical solution already. The idea is essentially to grab a piece of debris with a special satellite and de-orbit both of them, in the process burning up both objects above the aforementioned ‘spacecraft cemetery’.

Other technologies include moving objects with a powerful laser beam. It is important to start doing that soon – current scientific estimates predict that without active debris removal, certain orbits will become unusable over the coming decades.

Though it is hard to capture objects that are moving as fast as this debris, it is certainly possible. After all, spacecraft dock with the ISS all the time.

The bigger issues are financing and international cooperation. The question of who pays for these ‘garbage collection’ missions is a tricky one. Perhaps even trickier, is negotiating the international diplomatic space and persuading, for example Russia, that their old military satellite needs to be de-orbited by a technology company.

[photo omitted]

The second part of the puzzle to ensure the long-term accessibility of orbits is to adjust our current behaviour in space in order to minimize the creation of new debris. We need to be more careful with existing operational satellites and new missions.

The UN guidelines on space debris mitigation are among the key international efforts to get different actors to follow proper rules of the road, but they are voluntary.

There are over 1,500 active satellites in various orbits, but this figure is set to grow dramatically over the coming years.

Large constellations that number hundreds and thousands of satellites, such as OneWeb and SpaceX, are being developed currently (mostly for LEO orbits), and promise to provide affordable connectivity to all parts of the world.

New governments are also entering the race to get access to space. The question is, with such an increase in traffic, how do we get all the private and public actors to think more sustainably?

The [Global Future Council on Space Technologies](https://www.weforum.org/communities/the-future-of-space-technologies) is working on an industry framework to incentivize private actors to step up their act. Other efforts are needed.

Orbits are a critical part of the Earth environment, a global commons just like the oceans, and we need to protect this resource for future generations.

#### SSA solves collisions

Hitchens and Johnson-Freese 16 (Theresa Hitchens and Joan Johnson-Freese. Johnson-Freese is a professor of national security affairs at the Naval War College in Newport, Rhode Island. Theresa Hitchens is a Senior Research Scholar at the University of Maryland’s Center for International and Security Studies at Maryland (CISSM), and former Director of the United Nations Institute for Disarmament Research (UNIDIR). “Toward a New National Security Space Strategy Time for a Strategic Rebalancing,” Atlantic Council Strategy Papers, No. 5, 2016, <https://www.atlanticcouncil.org/images/publications/AC_StrategyPapers_No5_Space_WEB1.pdf>)

Improved SSA is a foundational capability for any US space strategy in any and all circumstances, given the rapid changes in the space environment. The national space security community has recognized this repeatedly, although funding has arguably not been commensurate with the rhetoric. Attempts are now being made to rectify the funding situation because of the Russia/China threat scare. According to the Government Accountability Office (GAO), the Obama administration is planning to spend about $6 billion between 2015 and 2020 to beef up SSA capabilities—largely within the Pentagon, but also at contributing agencies NOAA and NASA.50 Calculating exact spending on SSA activities, however, is not possible due to the way the Defense Department tracks (or, rather, does not track) related spending. According to the GAO report:

• Compiling a budget for all SSA-related efforts is a challenge because many assets that support the SSA mission do not have it as their primary mission.

• DOD is not required to and does not track the budgets specific to its SSA efforts for multiple-mission systems, and it does not estimate what percentage would be allocated to SSA.

• For example, some portion of the ballistic missile defense sensors budget, which averages about $538 million per fiscal year over the next few years, supports SSA, but DOD does not track the efforts of multi-mission sensors in a manner that would provide such data.

• SSA-related efforts performed using intelligence community sensor systems are also not included in the core SSA budget because those efforts and their budgets are classified.51

SSA is also an area ripe for possible leveraging of commercial and foreign capabilities, both to provide resilience and to complicate an adversary’s calculations regarding an attack—one of the stated goals of the Obama administration’s NSP. However, that potential has yet to be fully exploited, and greater emphasis should be put on doing so.

On June 1, 2015, US Strategic Command (STRATCOM) initiated a six-month pilot program to research how to integrate commercial operators (and their SSA data) into the JSpOC, called the Commercial Integration Cell. The initial effort involves six operators: Intelsat, SES Government Solutions, Inmarsat, Eutelsat, DigitalGlobe, and Iridium Communications. The goal is to assess whether JSpOC operations can be enhanced via integration of industry capabilities and insights, and, if so, how.52 The pilot program comes after years of lobbying by industry, including through SDA, for closer cooperation and collaboration between commercial operators and the US military on space-object data tracking. One major hurdle has been that the computer systems and models used by JSpOC are antiquated, and incompatible with more up-to-date industry practices. While updates are planned, given the lack of adequate budget resources, this situation is not likely to be rectified anytime soon. This misalignment between ways and means should be addressed as soon as possible by the incoming administration.

Another question is the extent to which US allies will be allowed access to the improved SSA data, including the interference warnings and collision analysis it will provide.53 The issue with allies is not just technical, but also, and primarily, political. The uncertainty in the private sector about JSpOC-industry collaboration and data sharing is underscored by AGI’s COMSpOC. AGI is seeking to tap into the expanded (and unfilled by JSpOC) need for such data in the commercial marketplace, both in the United States and abroad.54

Lieutenant General John W. Raymond, Commander of the Joint Functional Component Command for Space, told the House Armed Services Strategic Forces Subcommittee on March 25, 2015, that STRATCOM is working on a new “tiered SSA Sharing Strategy.” Raymond stated: “The tenets of this strategy are to share more information in a timelier manner with the broadest range of partners. We aim to promote an interactive, exchange-based relationship with satellite 35 owners and operators where all parties gain. This open exchange of information also supports U.S. and allied efforts to detect, identify, and attribute actions in space that are contrary to responsible use and the long-term sustainability of the space environment.” He further noted that, as of March 2015, there were forty-six SSA-sharing agreements in place with forty-six commercial firms, eight nations, and two intergovernmental organizations, with ten more in the works.55 (The number of such SSA agreements, as of March 2016, is now at sixty-three.)56

The word “tiered” in Raymond’s statement is central, as part of the issue for the Defense Department is figuring out what data to share with whom, at what level of specificity and accuracy. There has traditionally been reluctance about “giving away the store,” particularly because many allies more closely integrate their civilian and military space operations, with less of a focus on protecting national security secrets. It is hard to underestimate the challenges— for example, simply regarding security clearances for access to US data. Further, some nations are leery of relying too closely on information provided by the US military. For this very reason, the European Union (EU) in 2009 launched an effort to pursue independent SSA capabilities— an effort that has proceeded in fits and starts, due to internal EU concerns about the sharing of both information and funding. As of early 2015, the nascent program is being funded by fourteen participating EU states, focusing largely on figuring out how to better coordinate European activities, but also looking at how to improve capabilities.57According to the European Space Agency (ESA): “To date, Europe’s access to information on what is happening in space has been largely dependent on non-European sources. In recent years, for example, data to trigger alerts on potential collisions between European satellites and debris objects have only come through the good will of other spacefaring nations. For this and other reasons, Europe needs an autonomous SSA capability.”58 It remains unclear how the EU SSA system, once established, will interact with that of the United States. This should be a major focus of future US space diplomacy and cooperation, to ensure that the systems are compatible and accessible—in part, to provide mission assurance.

The United States signaled its desire to forge the closest partnership on SSA sharing with Australia, Canada, and the United Kingdom, via a Memorandum of Understanding on Combined Space Operations, signed in September 2014.59 The details of the MoU, however, are vague.60 It should be noted that all three countries have assets that could contribute to US efforts, and would not simply benefit from a one-way absorption of US data.

Also, it is not only US allies who require better SSA in order to operate satellites safely and securely. More than seventy countries operate satellites, with 1,381 operating satellites in orbit at the end of 2015.61 Many of these operators lack sufficient SSA. In the July 2013 report adopted by the UN General Assembly in October 2013, the Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities cited the need for improved global access to space data, both for safety purposes and for building trust. The report stated that, beyond a lack of space capacity, “the inability of many States to acquire significant space-based information” is a factor “contributing to the lack of confidence.”62 Russia has proposed to the COPUOS Scientific and Technical Subcommittee that the UN Office of Outer Space Affairs consider the development of an international, open database of on-orbit objects (both operational satellites and debris) to fill this gap.63 The United States and its allies have rejected the Russian proposal, largely for budgetary reasons, but the United States has been internally mulling over a possible proposition to create an informal international group to discuss the challenges to sharing SSA data and how to overcome them. This would be a promising first step, and a testimony to continued leadership in SSA by the United States, consistent with a national space strategy aimed at reducing risks. Inevitably, some form of open-access space-object database is going to be required, simply to ensure on-orbit safety—particularly in LEO, as the number of so-called Cubesats (very small satellites) rises 37 dramatically. The United States should take the lead on developing a workable space-traffic management regime underpinned by SSA.

#### And miscalc

Green 14 (Brian D. Green, “Space Situational Awareness Data Sharing: Safety Tool or Security Threat?” A thesis submitted to McGill University in partial fulfillment of the requirements of the degree of MASTER OF LAWS, December 2014, <http://digitool.library.mcgill.ca/webclient/StreamGate?folder_id=0&dvs=1569190779049~368>)

Countries with SSA capabilities would not need to reveal those types of critical information to provide warnings when a collision appears imminent, and thus could provide such warnings even for the benefit of a hostile country. If, for example, the United States detected that Iran’s Sina-1 satellite was in danger of colliding with another space object, it could issue Iran the warning without compromising the security of its own assets. If the US or an ally was in control of the satellite that was in danger of colliding, it could also perform or recommend a collision avoidance maneuver on its own. In either case, collision avoidance procedures would not require a country to provide potentially sensitive details such as a satellite’s current mission tasking, sensor resolution, or design blueprints. However, they could both avert a space-debris producing accident and show good faith in a way that could keep international tensions from escalating.

#### **First plank alone is sufficient – we will insert rehighlightings of their internal link ev --**

#### 1AC Shen & Blake is about constellation debris – Harker Inserts Blue

Shen & Blake 2/24/22 [Zili Shen, Internally citing James Blake \* I am a Ph.D. student in Astronomy at Yale University. My research focuses on ultra-diffuse galaxies and their globular cluster populations. Since I came to Yale, I have worked on two "dark-matter-free" galaxies NGC1052-DF2 and DF4 \*\* Department of Physics and Centre for Space Domain Awareness, University of Warwick, Coventry. “How not to bury ourselves under space trash.” astrobites. <https://astrobites.org/2022/02/24/space-sustainability/>] Justin

What’s wrong with having some stuff orbiting the Earth, you might ask? Like my trash analogy, the problem is that they block our way to space. Fragments as small as 10 cm can kill a satellite mission. Unlike my trash analogy, if enough space junk accumulates, they can produce more fragments on their own. Several bands of LEO are already at risk of what’s called a runaway collisional cascade. This happens when space junk collide with each other and fall apart, their fragments going on to seeding more collisions, generating more debris, and restarting the cycle. On the other hand, space debris in high altitude orbits (like GSO) don’t experience much atmospheric drag, and will stay up there for centuries. From this you probably gathered that most of these debris are either abandoned satellites or their fragments. Even though these objects were originally launched by humans, cataloging and tracking them are a huge challenge.

What’s up there?

Since the first manmade satellite was launched in 1957, space agencies have been keeping track of bodies orbiting the Earth. By mass, 98% of those are satellites and rocket bodies, but we know very little about the remaining 2%, millions of small debris. These small debris elude radars and optical telescopes used in ground-based surveys, but they can still cause mission-fatal damage to a satellite. With limited data, NASA and ESA cannot accurately estimate the risk from orbital debris. Their models don’t even agree on the number of expected debris because there is no good observational constraint for very small fragments.

Fig. 2: Number of tracked objects in Low-Earth Orbit (LEO) and Geo-synchronous orbit (GSO). Modified from Fig.2 of the paper.

Fig. 2 shows a breakdown of what we do know about objects in LEO and GSO. In LEO (left panel) , the most numerous objects are debris. These come from fragmentation events, or “break-ups,” most commonly due to propulsion-related subsystems exploding. In other words, when leftover fuel gets heated up in space, it can blow the satellite to pieces. Other sources of debris include intentional anti-satellite tests (in which countries develop technology to destroy each other’s satellites) and a small number of accidental satellite collisions. In GSO (right panel), a large number of objects are “unknown” because GSO is significantly farther away from Earth and has historically received less attention. To quote Dr. Blake, the author of today’s paper, “monitoring the mess of near-Earth space cannot solve the problem entirely, especially while the bulk of the dangerous debris population remains invisible and uncatalogued.” Now that I’ve alerted you to the grave danger we face, how do we make sure that future humanity can still go to space?

What can be done?

Like any environmental problem, the best solution is prevention. To prevent leftover fuel from exploding, satellite operators are now advised to “passivate” the spacecraft at the end of the mission. That means dumping out residual fuel and discharging batteries while they still control the spacecraft. The other safe disposal measures after the mission ends are to have the satellite re-enter the atmosphere or move into unused high-altitude orbits. Even though these prevention measures are the best way forward, they are (un)surprisingly hard to enforce. The authors says, “despite an apparent consensus that [anti-satellite weapon] tests represent irresponsible and reckless behaviour, legally binding and internationally recognised regulations are still lacking.” The level of adherence to the above safety guidelines remain concerningly low. Given that prevention is a “legal quagmire,” we can also try to remove debris that is already up there. Everything from harpoons to nets and tentacles have been used to collect orbital debris, but there’s no one-size-fits-all solution. Imagine how hard it is to capture metal shards tumbling at high speed without creating more debris.

Looking towards the future

Small satellites have flourished in recent years as LEO satellite constellations proved commercially lucrative. These satellites are not only a problem for astronomers but also a huge issue for the existing surveillance infrastructure. Dr. Blake says, “the problem is one that affects all operators in space, truly global in nature… [and] warrants a cross-sector, cross-disciplinary approach.” As astronomers, we can help society keep a watchful eye and ensure that the future of space flight is sustainable. If you want to learn more about space sustainability, Dr. Blake recommends the GNOSIS project.

#### 1AC Byers and Boley is too – Harker inserts blue

Boley and Byers 21. Aaron Boley is at the Department of Physics and Astronomy, The University of British Columbia, Vancouver, Canada and Michael Byers is at the Department of Physics and Astronomy, The University of British Columbia, Vancouver, Canada. 5/20/21. [Nature, “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth,” <https://www.nature.com/articles/s41598-021-89909-7>] Justin

Companies are placing satellites into orbit at an unprecedented frequency to build ‘mega-constellations’ of communications satellites in Low Earth Orbit (LEO). In two years, the number of active and defunct satellites in LEO has increased by over 50%, to about 5000 (as of 30 March 2021). SpaceX alone is on track to add 11,000 more as it builds its Starlink mega-constellation and has already fled for permission for another 30,000 satellites with the Federal Communications Commission (FCC)1 . Others have similar plans, including OneWeb, Amazon, Telesat, and GW, which is a Chinese state-owned company2 . Te current governance system for LEO, while slowly changing, is ill-equipped to handle large satellite systems. Here, we outline how applying the consumer electronic model to satellites could lead to multiple tragedies of the commons. Some of these are well known, such as impediments to astronomy and an increased risk of space debris, while others have received insufcient attention, including changes to the chemistry of Earth’s upper atmosphere and increased dangers on Earth’s surface from re-entered debris. Te heavy use of certain orbital regions might also result in a de facto exclusion of other actors from them, violating the 1967 Outer Space Treaty. All of these challenges could be addressed in a coordinated manner through multilateral law-making, whether in the United Nations, the Inter-Agency Debris Committee (IADC), or an ad hoc process, rather than in an uncoordinated manner through diferent national laws. Regardless of the law-making forum, mega-constellations require a shif in perspectives and policies: from looking at single satellites, to evaluating systems of thousands of satellites, and doing so within an understanding of the limitations of Earth’s environment, including its orbits.

Tousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3 . Tere are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraf and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4 . Te addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5–8 .

[Omitted Figures 1 and 2]

Results

The overall setting. Te rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defnes NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with efects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph.

Although the volume of space is large, individual satellites and satellite systems have specifc functions, with associated altitudes and inclinations (Fig. 2). Tis increases congestion and requires active management for station keeping and collision avoidance9 , with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, afer failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency

When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. Te satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under diferent national regulatory regimes, are soon likely to follow.

Enhanced collision risk. Mega-constellations are composed of mass-produced satellites with few backup systems. Tis consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difcult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb megaconstellations as fled (and amended) with the FCC (see “Methods”). Te large density spikes show that some shells will have satellite number densities in excess of n = 10−6 km−3 .

Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-thanfully transparent about events13 in LEO.

Despite the congestion and trafc management challenges, FCC flings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the flings do not account for untracked debris6 , including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 afer one year. Tus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur.

Fragmentation events are not confned to their local orbits, either. Te India 2019 ASAT test was conducted at an altitude below 300 km in an efort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could afect all operators in LEO.

#### Same with Samson – Harker is blue

Samson 22 – Victoria Samson is the Washington office director for the Secure World Foundation, an organization that focuses on space sustainability, and she has over 20 years of experience in military space and security issues. Previously, Ms. Samson was a senior analyst for the Center for Defense Information. She also was a senior policy associate at the Coalition to Reduce Nuclear Dangers, a consortium of arms control groups. Earlier, she was a researcher at Riverside Research Institute, where she worked on war-gaming scenarios for the Missile Defense Agency. 1/17/22. [Bulletin of the Atomic Scientists, “The complicating role of the private sector in space,” DOI: 10.1080/00963402.2021.2014229] Justin

At this exact moment, we are seeing the increasing dominance of commercial actors in space – specifically the rise of mega-constellations, or large numbers of small satellites flying in formation to provide global coverage for a variety of governmental and commercial uses, including both communications and Earth observation. Consequently, the fundamental nature of space is changing, to one of a domain dominated by commercial actors. This change will have major consequences for international stability, both in terms of how it demonstrates that the old governance structure for space is being left behind – and how it highlights Russia’s declining rank in global space powers. Certain orbits may be effectively taken over by a handful of entities, and there will be competition for useful portions of the electromagnetic spectrum. With eyes on the sky everywhere, there will be little or no room for state secrets – for better or worse. This is happening at the same time that Russia’s space identity is floundering, which may further upset the stability of the domain of space.

As of November 2021, there are roughly 4,800 active satellites in orbit around Earth, around 1,850 of which belong to just one entity: SpaceX’s Starlink mega-constellation (Thompson 2021). This change has happened very quickly, as Starlink satellites just began to be launched in May 2019 (O’Callaghan 2019). This is only the first wave of the megaconstellations as well. While it is hard to say exactly how many satellites will be launched as part of this new use of space, there are requests or plans for mega-constellations that could mean well over 100,000 new satellites could potentially be in low Earth orbit. While not all of these satellites will be launched, even a small fraction of that proposed number will fundamentally shift the situation so that the major actors in space will no longer be nation-states (as has been the case to date) but the private sector, changing the timbre of the space domain.

This leads to challenges in discussing space security issues: Space is a shared, international domain; if we cannot include all the stakeholders in the discussions, we will not come to complete solutions to the problems. But first, some background.

A little history

The commercial sector is not new to space. Commercial entities have been active in space for decades now; in fact, it was a dispute over what should be the extent of their role in space that shaped part of the 1967 Outer Space Treaty. Article VI of that treaty notes:

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities . . .. The activities of nongovernmental entities in outer space, including the moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. (Outer Space Treaty 1967)

This was a compromise between the United States and the USSR, in which the latter argued that there was no such thing as commercial space. Having language requiring state actors to carry out “authorization and continuing supervision” gave the United States the flexibility it wanted to develop a commercial space sector while ensuring that there would still be national oversight.

A lack of coordination

One way in which the rise of these mega-constellations may complicate international security in space is through concerns about these satellites hampering access to certain orbits. While slots in geosynchronous Earth orbit are set by the International Telecommunication Union, there is no international entity coordinating orbital slots at low Earth orbit. This means that, given the potentially tens of thousands of satellites that could be launched given company plans, certain orbits could be de facto ceded to a handful of entities – in defiance of Article II of the Outer Space Treaty, which says that space “is not subject to national appropriation.” Consequently, this could lead to strife or competition over certain orbits.

It is possible that, given the number of satellites that companies are asking the United States’ Federal Communications Commission for broadcasting rights to, certain orbits may reach their carrying capacities – meaning that they are at the maximum number of satellites that can be operated, as defined by physical and radiofrequency interference aspects. This could lead to disputes over which country has the right to use certain orbits, or, alternatively, resentment when one country’s commercial sector essentially takes over a particular orbit

Competition over parts of the electromagnetic spectrum is another possible path for international security issues to arise from mega-constellations. Satellites are only as good as their ability to receive and communicate information, which requires spectrum; if one or a few entities from one country use up all the readily accessible spectrum for specific capabilities at certain orbits, that could possibly lead to confrontation as well. For the most part, the companies launching mega-constellations are largely based in the West, which can shape the global perception of their effects and intent – although there have been some plans for at least one Chinese company to launch a mega-constellation of potentially 13,000 satellites, and the South Koreans have expressed interest in their own mega-constellation.

## Case

### Framing

#### Extinction first/consequentlism –

#### 1. Risk of extinction focus paralyzes action – any action has a risk of causing extinction but so does not acting – we’d have to listen to a random person who told us to jump out of the building right now or else extinction would happen

#### 2. This assumes we don’t know what’s ethically bad but we don’t need more time to morally figure out that structural violence like racism is wrong – if there’s a high risk of that vote NEG

#### 3. This is another link – it justifies the 1% risk cheney doctrine of intervening in the middle east for a false threat, which was a worse political solution and caused massive suffering – this is the exact fear based politics that all of the K criticizes

#### Reject MacAskill – cut in the middle of a para – drop their card and presume our framework is true – rest inserted in red

MacAskill 14 [William, Oxford Philosopher and youngest tenured philosopher in the world, Normative Uncertainty, 2014]

The human race might go extinct from a number of causes: asteroids, supervolcanoes, runaway climate change, pandemics, nuclear war, and the development and use of dangerous new technologies such as synthetic biology, all pose risks (even if very small) to the continued survival of the human race.184 And different moral views give opposing answers to question of whether this would be a good or a bad thing. It might seem obvious that human extinction would be a very bad thing, both because of the loss of potential future lives, and because of the loss of the scientific and artistic progress that we would make in the future. But the issue is at least unclear. The continuation of the human race would be a mixed bag: inevitably, it would involve both upsides and downsides. And if one regards it as much more important to avoid bad things happening than to promote good things happening then one could plausibly regard human extinction as a good thing.For example, one might regard the prevention of bads as being in general more important that the promotion of goods, as defended historically by G. E. Moore,185 and more recently by Thomas Hurka.186 One could weight the prevention of suffering as being much more important that the promotion of happiness. Or one could weight the prevention of objective bads, such as war and genocide, as being much more important than the promotion of objective goods, such as scientific and artistic progress. If the human race continues its future will inevitably involve suffering as well as happiness, and objective bads as well as objective goods. So, if one weights the bads sufficiently heavily against the goods, or if one is sufficiently pessimistic about humanity’s ability to achieve good outcomes, then one will regard human extinction as a good thing.187 However, even if we believe in a moral view according to which human extinction would be a good thing, we still have strong reason to prevent near-term human extinction. To see this, we must note three points. First, we should note that the extinction of the human race is an extremely high stakes moral issue. Humanity could be around for a very long time: if humans survive as long as the median mammal species, we will last another two million years. On this estimate, the number of humans in existence in the The future, given that we don’t go extinct any time soon, would be 2×10^14. So if it is good to bring new people into existence, then it’s very good to prevent human extinction. Second, human extinction is by its nature an irreversible scenario. If we continue to exist, then we always have the option of letting ourselves go extinct in the future (or, perhaps more realistically, of considerably reducing population size). But if we go extinct, then we can’t magically bring ourselves back into existence at a later date. Third, we should expect ourselves to progress, morally, over the next few centuries, as we have progressed in the past. So we should expect that in a few centuries’ time we will have better evidence about how to evaluate human extinction than we currently have. Given these three factors, it would be better to prevent the near-term extinction of the human race, even if we thought that the extinction of the human race would actually be a very good thing. To make this concrete, I’ll give the following simple but illustrative model. Suppose that we have 0.8 credence that it is a bad thing to produce new people, and 0.2 certain that it’s a good thing to produce new people; and the degree to which it is good to produce new people, if it is good, is the same as the degree to which it is bad to produce new people, if it is bad. That is, I’m supposing, for simplicity, that we know that one new life has one unit of value; we just don’t know whether that unit is positive or negative. And let’s use our estimate of 2×10^14 people who would exist in the future, if we avoid near-term human extinction. Given our stipulated credences, the expected benefit of letting the human race go extinct now would be (.8-.2)×(2×10^14) = 1.2×(10^14). Suppose that, if we let the human race continue and did research for 300 years, we would know for certain whether or not additional people are of positive or negative value. If so, then with the credences above we should think it 80% likely that we will find out that it is a bad thing to produce new people, and 20% likely that we will find out that it’s a good thing to produce new people. So there’s an 80% chance of a loss of 3×(10^10) (because of the delay of letting the human race go extinct), the expected value of which is 2.4×(10^10). But there’s also a 20% chance of a gain of 2×(10^14), the expected value of which is 4×(10^13). That is, in expected value terms, the cost of waiting for a few hundred years is vanishingly small compared with the benefit of keeping one’s options open while one gains new information.

#### Structural violence – extinction is all or nothing vs ontology means it’s a cyclical structure 🡪 neg

#### Busbridge

#### 1. Busbridge conflates hope in the current bounds of the political and a hope in decolonization. We don’t see progress within politics as it exists right now but don’t cede all hope – our energy ought to be invested in a practice and ethics of decolonization

#### 2. This presumes progress without justifying it – indigenous people die at the highest rates in the country with the worst quality of living, their culture is irreparably damaged by being disconnected from their land, and they have no avenue of proper integration into the fake ILO.

#### Hurley –

#### 1. This presumes that indigenous people are included within the calculus of policymakers and that their lives are viewed as valuable by settler colonial society – they have to win ontology to win this claim

#### 2. We’ve made a uniqueness argument that indigenous people experience constant genocide and there is no organizing that contributes to a meaningful decol movement from that. Extinction just further allows settler moves to innocence that shifts focus from indigenous struggles to white maintenance of power

#### Barker –

### Advantage

#### Companies would just claim that their operations don't produce debris even if they did which takes out the aff

#### Tons of alt causes to debris – ASATs, decaying satellites, launches, and tons of existing material –

#### 1AC ev mentions kessler and cascades like twice - hold the line on 1AR explanation and don't let them weigh the sum total of satellites going away

#### No Kessler

Drmola and Hubik 18 [Jakub Drmola, Division of Security and Strategic Studies, Department of Political Science at the Faculty of Social Sciences of Masaryk University. Tomas Hubik, Department of Theoretical Computer Science and Mathematical Logic, Faculty of Mathematics and Physics, Charles University. Kessler Syndrome: System Dynamics Model. Space Policy Volumes 44–45, August 2018, Pages 29-39. https://www.sciencedirect.com/science/article/pii/S0265964617300966?via%3Dihub]

The baseline scenario represents a continuation of the current trends, which are simply extended into the future. An average 1% growth rate of yearly launches of new satellites (starting at 89) is assumed, together with constant success rate in satellites’ ability to actively avoid collisions with debris and other satellites, constant lifetime, and failure rate. This basic model lacks any sudden events or major policy changes that would markedly influence the debris propagation. However, it serves both as a foundation for all the following scenarios and as a basis of comparison to see what the impact would be.

Given high uncertainty regarding future state of the satellite industry (how many satellites will be launched per year, of what type and size, etc.), we elected to limit our simulations to 50 years. The model can certainly continue beyond this point, but the associated unknowns make the simulations progressively less useful.

Running this model for its full 50 years (2016–2066) yields the expected result of perpetually growing amount of debris in the LEO. One can observe nearly 2-fold increase in the large debris (over 10 cm) and 3-fold increase in small debris (less than 1 cm) quantities (Fig. 5). The oscillations visible in the graph are caused by the aforementioned solar cycles which influence the rate of reentry for all simulated populations except the still active (i.e. powered) satellites. Also please note that throughout the article, the graphs use quite different scales for debris populations because of the considerable variations between scenarios. Using any single scale for all graphs would render some of them unintelligible.

We can see that this increase in numbers still does not result in realization of the Kessler syndrome as most of the satellites being launched remain intact for their full expected service life. However, it comes with a considerable increase in risk to satellites, which is manifested by their higher yearly losses, making satellites operations riskier and more expensive for governments and private companies alike. This increased amount of debris in LEO combined with the larger number of active satellites makes it approximately twice as likely that an active satellite will suffer a disabling hit or a total disintegration during its lifetime. It should be noted that this risk might possibly be offset by future improvements in satellite reliability, debris tracking, and navigation [17].

#### Even full-scale ASAT war can’t trigger Kessler – modelling

Drmola and Hubik 18 [Jakub Drmola, Division of Security and Strategic Studies, Department of Political Science at the Faculty of Social Sciences of Masaryk University. Tomas Hubik, Department of Theoretical Computer Science and Mathematical Logic, Faculty of Mathematics and Physics, Charles University. Kessler Syndrome: System Dynamics Model. Space Policy Volumes 44–45, August 2018, Pages 29-39. https://www.sciencedirect.com/science/article/pii/S0265964617300966?via%3Dihub]

The probabilities and rates of collisions of objects from different groups were calculated using a coefficient converting the rate of collisions between objects from one group to the rate of collisions between objects from another group. The initial base rate was estimated using iterative simulations and comparison of the resulting runs with real data and outputs from other models. Detailed model built by a group of researchers from the Lawrence Livermore National Laboratory was used as a base for the calibration [see 9]. As the major factor influencing collision probability is size, the probability increases with square of the diameter representing bigger area for possible impact. Speed would be another factor influencing the probability of impacts, but the speed depends on the distance from the Earth and is not influenced by debris size. It means that it will not vary between different debris groups and thus will not influence the collision probability conversion parameters in our model.

One the most important limitations and simplifications of the model is the uncertainty of size, structure, and composition of the satellites—i.e. what debris the satellite will disintegrate into in case of a collision. Perhaps even more crucially, the rate of orbital decay changes significantly with the altitude and eccentricity of the trajectory. The lower the orbital altitude is or the more eccentric it is, the more drag the object experiences as it passes through the last vestiges of our atmosphere. Therefore, objects in the lower or more eccentric orbit will decay significantly faster. Thus, the actual lifetime of a piece of debris can easily vary from days to centuries. It also needs to be noted that while it may take many decades for a satellite to decay (especially from the popular orbits between 500 km and 800 km), we cannot assume the same about debris. That is because while satellite orbits typically have very low eccentricity, collisions result in fragments with velocities and trajectories that vary and differ from the original intact satellite (i.e. are more eccentric and decay faster). This makes estimating rate of orbital decay of debris quite difficult, especially when combined with the ongoing laudable efforts by Inter-Agency Space Debris Coordination Committee (IADC) to shorten the lifetime of satellites after they cease planned operations [14], [15].

Therefore, both the orbital and structural parameters used here are (and must be) overall averages designed to represent a “general LEO satellite” and are based on previous fragmentations, of which there are but few. Furthermore, this is getting increasingly more difficult as satellites are getting progressively more diverse, especially with the ongoing boom of the miniaturized CubeSats [16]. This leads to a relatively wide and heterogeneous population of real satellites being represented by a single, homogenized stock of simulated satellites in the model. It is also uncertain and difficult to predict how exactly is this going to evolve in the far future, what proportion of launched satellites will be of which size, and into which orbit they will be placed. Lacking precise information, we simply extrapolate current and expected trends.

5. Scenarios and simulation results

5.1. Business as usual and beyond

The baseline scenario represents a continuation of the current trends, which are simply extended into the future. An average 1% growth rate of yearly launches of new satellites (starting at 89) is assumed, together with constant success rate in satellites’ ability to actively avoid collisions with debris and other satellites, constant lifetime, and failure rate. This basic model lacks any sudden events or major policy changes that would markedly influence the debris propagation. However, it serves both as a foundation for all the following scenarios and as a basis of comparison to see what the impact would be.

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This negative development of increasingly risky and costly operation of satellites can also be highlighted and visualized in a graph by comparing the number of satellites launched to the number of satellites lost (to collisions as well as malfunctions) in each given year (Fig. 6). This ratio shows diminishing efficiency of the system, where number of losses per launch increases.

After fully acknowledging limitations stemming from inherent uncertainties, we can also try to “make things expectedly worse” by doubling the growth rate of yearly launches (to what it perhaps might end up being because of the boom in satellites industry because of increasing privatization of space, growing demand for communication satellites, etc.) and also extending the simulation timeframe to 200 years (Fig. 7).

It must be stressed that the model was not designed with such long outlooks in mind, and many of the assumptions will certainly not hold over the next 200 years (such as static launch rate growth, size, and structure of the satellites, their lifetime, evasion rates, lack of mitigation, and many others). But in the overwhelmingly unlikely case that these assumptions stay true, the simulated outcome seems to suggest a collapse of sorts around the year 2163. However, it does not look like a suddenly triggered chain reaction leading to widespread fragmentation of the entire LEO but rather like a gradually reached point at which LEO is so full of debris, and the rate of active satellite fragmentation is so high (almost one every day) that the launches cannot keep up anymore. This is consistent with the findings reported by LaFleur and Finkelman, who found the debris system to be unconditionally stable [18], [19], [27].

5.2. Antisatellite weapon system scenario

Apart from the usual collisional risks that satellites face in the LEO, there has been growing concern regarding the development of antisatellite weapon systems (ASATs) by several world powers (namely China, Russian Federation, and the United States). These weapons are designed to intercept and destroy orbiting satellites and are, for the most part, descended from the antiballistic missile defense systems. While there are some alternative designs under development, the current generation mostly takes form of a boosted missile with a kinetic kill vehicle. This method of destruction (a collision of a missile with a satellite) leads to extensive fragmentation and creation of large debris clouds.

A prime example of this was the Chinese 2007 ASAT test which destroyed China's own decommissioned weather satellite FengYun-1C. This hypervelocity collision created around 3000 pieces of medium to large debris and tens of thousands of smaller pieces, most of which will remain in orbit for decades, thus considerably contributing to overall risk of future orbital collisions [20].

As much as occasional tests of ASATs are increasing the amount of debris in the LEO, a greater danger by far is the possibility of a large-scale ASAT deployment during an armed conflict between two or more major, technologically advanced powers. Given the reliance of modern militaries on satellites for intelligence, communication, and navigation, it is generally presumed that the initial phase of any such conflict would involve mutual destruction of each other's satellites to blind the enemy and hinder their offensive operations [21], [22]. Such opening salvos could involve immediate destruction of dozens of satellites, thus creating massive clouds of debris threatening the remaining satellites and possibly leading to cascading disintegration across the entire orbit.

This kind of hypothetical event is simulated in the second scenario, where an imaginary major military conflict erupts in the year 2040, during which roughly half of all military satellites are destroyed by intentional kinetic impacts using antisatellite weapons. With military and dual-use satellites generally representing a little over one-third of all satellites [23] (depending on criteria and the operating country), this results in some 200 satellites destroyed by ASATs in 2040 (Fig. 8).

However, even this sudden event is not enough to trigger a chain reaction of satellites disintegrating in LEO, at least according to this model. Nevertheless, the number of collisions with active satellites ends up nearly twice as high at the end of the simulation (i.e. 25 years after the conflict and ASAT strikes) when compared to the previous run. This shows that the damage would be long-term and would negatively affect satellite operations (including commercial and scientific ones) for many years after any conflict involving ASATs

#### No one’s going to war over a downed satellite

Bowen 18 [Bleddyn Bowen, Lecturer in International Relations at the University of Leicester. The Art of Space Deterrence. February 20, 2018. https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/]

Space is often an afterthought or a miscellaneous ancillary in the grand strategic views of top-level decision-makers. A president may not care that one satellite may be lost or go dark; it may cause panic and Twitter-based hysteria for the space community, of course. But the terrestrial context and consequences, as well as the political stakes and symbolism of any exchange of hostilities in space matters more. The political and media dimension can magnify or minimise the perceived consequences of losing specific satellites out of all proportion to their actual strategic effect.

#### Sat attacks don’t cause nuke war

Zarybnisky 18 [Eric J. Zarybnisky, MA in National Security Studies from the Naval War College, PhD in Operations Research from the MIT Sloan School of Management, Lt Col, USAF. Celestial Deterrence: Deterring Aggression in the Global Commons of Space. March 28, 2018. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1062004.pdf>]

PREVENTING AGGRESSION IN SPACE

While deterrence and the Cold War are strongly linked in the public’s mind through the nuclear standoff between the United States and the Soviet Union, the fundamentals of deterrence date back millennia and deterrence remains relevant. Thucydides alludes to the concept of deterrence in his telling of the Peloponnesian War when he describes rivals seeking advantages, such as recruiting allies, to dissuade an adversary from starting or expanding a conflict.6F 6 Aggression in space was successfully avoided during the Cold War because both sides viewed an attack on military satellites as highly escalatory, and such an action would likely result in general nuclear war.7F 7 In today’s more nuanced world, attacking satellites, including military satellites, does not necessarily result in nuclear war. For instance, foreign countries have used highpowered lasers against American intelligence-gathering satellites8F 8 and the United States has been reluctant to respond, let alone retaliate with nuclear weapons. This shift in policy is a result of the broader use of gray zone operations, to which countries struggle to respond while limiting escalation. Beginning with the fundamentals of deterrence illuminates how it applies to prevention of aggression in space.

#### No credible scenario for extinction—outdated fringe science and well-meaning threat inflation

Scouras 19 (James Scouras, Johns Hopkins University Applied Physics Laboratory, formerly served on the congressionally established Comission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, “Nuclear War as a Global Catastrophic Risk”, Cambridge Core, 9-2-2019, available at https://www.cambridge.org/core/journals/journal-of-benefit-cost-analysis/article/nuclear-war-as-a-global-catastrophic-risk/EC726528F3A71ED5ED26307677960962, accessed 12-1-2019, HKR-cjh)

\*footnotes 2 and 4 included

It might be thought that we know enough about the risk of nuclear war to appropriately manage that risk. The consequences of unconstrained nuclear attacks, and the counterattacks that would occur until the major nuclear powers exhaust their arsenals, would far exceed any cataclysm humanity has suffered in all of recorded history. The likelihood of such a war must, therefore, be reduced as much as possible. But this rather simplistic logic raises many questions and does not withstand close scrutiny. Regarding consequences, does unconstrained nuclear war pose an existential risk to humanity? The consequences of existential risks are truly incalculable, including the lives not only of all human beings currently living but also of all those yet to come; involving not only Homo sapiens but all species that may descend from it. At the opposite end of the spectrum of consequences lies the domain of “limited” nuclear wars. Are these also properly considered global catastrophes? After all, while the only nuclear war that has ever occurred devastated Hiroshima and Nagasaki, it was also instrumental in bringing about the end of the Pacific War, thereby saving lives that would have been lost in the planned invasion of Japan. Indeed, some scholars similarly argue that many lives have been saved over the nearly threefourths of a century since the advent of nuclear weapons because those weapons have prevented the large conventional wars that otherwise would likely have occurred between the major powers. This is perhaps the most significant consequence of the attacks that devastated the two Japanese cities. Regarding likelihood, how do we know what the likelihood of nuclear war is and the degree to which our national policies affect that likelihood, for better or worse? How much confidence should we place in any assessment of likelihood? What levels of likelihood for the broad spectrum of possible consequences pose unacceptable levels of risk? Even a very low (nondecreasing) annual likelihood of the risk of nuclear war would result in near certainty of catastrophe over the course of enough years. Most fundamentally and counterintuitively, are we really sure we want to reduce the risk of nuclear war? The successful operation of deterrence, which has been credited – perhaps too generously – with preventing nuclear war during the Cold War and its aftermath, depends on the risk that any nuclear use might escalate to a nuclear holocaust. Many proposals for reducing risk focus on reducing nuclear weapon arsenals and, therefore, the possible consequences of the most extreme nuclear war. Yet, if we reduce the consequences of nuclear war, might we also inadvertently increase its likelihood? It’s not at all clear that would be a desirable trade-off. This is all to argue that the simplistic logic described above is inadequate, even dangerous. A more nuanced understanding of the risk of nuclear war is imperative. This paper thus attempts to establish a basis for more rigorously addressing the risk of nuclear war. Rather than trying to assess the risk, a daunting objective, its more modest goals include increasing the awareness of the complexities involved in addressing this topic and evaluating alternative measures proposed for managing nuclear risk. I begin with a clarification of why nuclear war is a global catastrophic risk but not an existential risk. Turning to the issue of risk assessment, I then present a variety of assessments by academics and statesmen of the likelihood component of the risk of nuclear war, followed by an overview of what we do and do not know about the consequences of nuclear war, emphasizing uncertainty in both factors. Then, I discuss the difficulties in determining the effects of risk mitigation policies, focusing on nuclear arms reduction. Finally, I address the question of whether nuclear weapons have indeed saved lives. I conclude with recommendations for national security policy and multidisciplinary research. 2 Why is nuclear war a global catastrophic risk? One needs to only view the pictures of Hiroshima and Nagasaki shown in figure 1 and imagine such devastation visited on thousands of cities across warring nations in both hemispheres to recognize that nuclear war is truly a global catastrophic risk. Moreover, many of today’s nuclear weapons are an order of magnitude more destructive than Little Boy and Fat Man, and there are many other significant consequences – prompt radiation, fallout, etc. – not visible in such photographs. Yet, it is also true that not all nuclear wars would be so catastrophic; some, perhaps involving electromagnetic pulse (EMP) attacks 2 Many mistakenly believe that the congressionally established Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack concluded that an EMP attack would, indeed, be catastrophic to electronic systems and consequently to people and societies that vitally depend on those systems. However, the conclusion of the commission, on whose staff I served, was only that such a catastrophe could, not would, result from an EMP attack. Its executive report states, for example, that “the damage level could be sufficient to be catastrophic to the Nation.” See www.empcommision.org for publicly available reports from the EMP Commission. See also Frankel et al., (2015).2 using only a few high-altitude detonations or demonstration strikes of various kinds, could result in few casualties. Others, such as a war between Israel and one of its potential future nuclear neighbors, might be regionally devastating but have limited global impact, at least if we limit our consideration to direct and immediate physical consequences. Nevertheless, smaller nuclear wars need to be included in any analysis of nuclear war as a global catastrophic risk because they increase the likelihood of larger nuclear wars. This is precisely why the nuclear taboo is so precious and crossing the nuclear threshold into uncharted territory is so dangerous (Schelling, 2005; see also Tannenwald, 2007). While it is clear that nuclear war is a global catastrophic risk, it is also clear that it is not an existential risk. Yet over the course of the nuclear age, a series of mechanisms have been proposed that, it has been erroneously argued, could lead to human extinction. The first concern3 arose among physicists on the Manhattan Project during a 1942 seminar at Berkeley some three years before the first test of an atomic weapon. Chaired by Robert Oppenheimer, it was attended by Edward Teller, Hans Bethe, Emil Konopinski, and other theoretical physicists (Rhodes, 1995). They considered the possibility that detonation of an atomic bomb could ignite a self-sustaining nitrogen fusion reaction that might propagate through earth’s atmosphere, thereby extinguishing all air-breathing life on earth. Konopinski, Cloyd Margin, and Teller eventually published the calculations that led to the conclusion that the nitrogen-nitrogen reaction was virtually impossible from atomic bomb explosions – calculations that had previously been used to justify going forward with Trinity, the first atomic bomb test (Konopinski et al., 1946). Of course, the Trinity test was conducted, as well as over 1000 subsequent atomic and thermonuclear tests, and we are fortunately still here. After the bomb was used, extinction fear focused on invisible and deadly fallout, unanticipated as a significant consequence of the bombings of Japan that would spread by global air currents to poison the entire planet. Public dread was reinforced by the depressing, but influential, 1957 novel On the Beach by Nevil Shute (1957) and the subsequent 1959 movie version (Kramer, 1959). The story describes survivors in Melbourne, Australia, one of a few remaining human outposts in the Southern Hemisphere, as fallout clouds approached to bring the final blow to humanity. In the 1970s, after fallout was better understood to be limited in space, time, and magnitude, depletion of the ozone layer, which would cause increased ultraviolet radiation to fry all humans who dared to venture outside, became the extinction mechanism of concern. Again, one popular book, The Fate of the Earth by Jonathan Schell (1982), which described the nuclear destruction of the ozone layer leaving the earth “a republic of insects and grass,” promoted this fear. Schell did at times try to cover all bases, however: “To say that human extinction is a certainty would, of course, be a misrepresentation – just as it would be a misrepresentation to say that extinction can be ruled out” (Schell, 1982). Finally, the current mechanism of concern for extinction is nuclear winter, the phenomenon by which dust and soot created primarily by the burning of cities would rise to the stratosphere and attenuate sunlight such that surface temperatures would decline dramatically, agriculture would fail, and humans and other animals would perish from famine. The public first learned of the possibility of nuclear winter in a Parade article by Sagan (1983), published a month or so before its scientific counterpart by Turco et al. (1983). While some nuclear disarmament advocates promote the idea that nuclear winter is an extinction threat, and the general public is probably confused to the extent it is not disinterested, few scientists seem to consider it an extinction threat. It is understandable that some of these extinction fears were created by ignorance or uncertainty and treated seriously by worst-case thinking, as seems appropriate for threats of extinction. But nuclear doom mongering also seems to be at play for some of these episodes. For some reason, portions of the public active in nuclear issues, as well as some scientists, appear to think that arguments for nuclear arms reductions or elimination will be more persuasive if nuclear war is believed to threaten extinction, rather than merely the horrific cataclysm that it would be in reality (Martin, 1982). 4 As summarized by Martin, “The idea that global nuclear war could kill most or all of the world’s population is critically examined and found to have little or no scientific basis.” Martin also critiques possible reasons for beliefs or professed beliefs about nuclear extinction, including exaggeration to stimulate action.4 To summarize, nuclear war is a global catastrophic risk. Such wars may cause billions of deaths and unfathomable suffering, as well set civilization back centuries. Smaller nuclear wars pose regional catastrophic risks and also national risks in that the continued functioning of, for example, the United States as a constitutional republic is highly dubious after even a relatively limited nuclear attack. But what nuclear war is not is an existential risk to the human race. There is simply no credible scenario in which humans do not survive to repopulate the earth.

#### No external to the grid just that other existential threats wouldn't be resolved - haven't identified threats are coming or why grid collapse independently cause extinction

#### Grid is resilient and sustainable

Clark, MA candidate – Intelligence Studies @ American Military University, senior analyst – Chenega Federal Systems, 4/28/’12 (Paul, “The Risk of Disruption or Destruction of Critical U.S. Infrastructure by an Offensive Cyber Attack,” American Military University)

In 2003, a simple physical breakdown occurred – trees shorted a power line and caused a fault – that had a cascading effect and caused a power blackout across the Northeast (Lewis 2010). This singular occurrence has been used as evidence that the electrical grid is fragile and subject to severe disruption through cyber-attack, a disruption that could cost billions of dollars, brings business to a halt, and could even endanger lives – if compounded by other catastrophic events (Brennan 2012). A power disruption the size of the 2003 blackout, the worst in American¶ history at that time (Minkel 2008), is a worst case scenario and used as an example of the¶ fragility of the U.S. energy grid. This perceived fragility is not real when viewed in the context¶ of the robustness of the electrical grid.¶ When asked about cyber-attacks against the electrical grid in April of 2012, the¶ intelligence chief of U.S. Cyber Command Rear Admiral Samuel Cox stated that an attack was¶ unlikely to succeed because of the “huge amounts of resiliency built into the [electrical] system¶ that makes that kind of catastrophic thing very difficult” (Capaccio 2012). This optimistic view¶ is supported by an electrical grid that has proven to be robust in the face of large natural¶ catastrophes. Complex systems like the electrical grid in the U.S. are prone to failures and the¶ U.S. grid fails frequently. Despite efforts to reduce the risk out power outages, the risk is always¶ present. Power outages that affect more than 50,000 people have occurred steadily over the last¶ 20 years at a rate of 12% annually and the frequency of large catastrophes remains relatively¶ high and outages the size of the 2003 blackout are predicted to occur every 25 years (Minkel¶ 2008). In a complex system that is always at risk of disruption, the effect is mitigated by policies¶ and procedures that are meant to restore services as quickly as possible. The most visible of these policies is the interstate Emergency Management Assistance Compact, a legally binding¶ agreement allowing combined resources to be quickly deployed in response to a catastrophic¶ disaster such as power outages following a severe hurricane (Kapucu, Augustin and Garayev¶ 2009).¶ The electrical grid suffers service interruptions regularly, it is a large and complex system¶ supporting the largest economy in the world, and yet commerce does not collapse (Lewis 2010).¶ Despite blizzards, earthquakes, fires, and hurricanes that cause blackouts, the economy is¶ affected but does not collapse and even after massive damage like that caused by Hurricane¶ Katrina, national security is not affected because U.S. military capability is not degraded (Lewis¶ 2010).¶ Cyber-security is an ever-increasing concern in an increasingly electronic and¶ interconnected world. Cyber-security is a high priority “economic and national security¶ challenge” (National Security Council n.d.) because cyber-attacks are expected to become the¶ top national security threat (Robert S. Mueller 2012). In response to the threat Congress is¶ crafting legislation to enhance cyber-security (Brito and Watkins 2012) and the Department of¶ Homeland Security budget for cyber-security has been significantly increased (U.S. Senate¶ Committee on Homeland Security and Governmental Affairs 2012).