### 1NC

#### Interpretation: The aff may not specify unjust types of space appropriation.

#### Violation – They specified large sats in LEO

#### Standards:

1] **Limits and ground – their model allows affs to defend any combination of appropriation in any geopolitical context which explodes negative burden and causes random affs every tournament**

#### Drop the debater on T – constituve rule of debate

#### Reject the arg on 1AR Theory

#### 1. Proportionality- punishment is worse than the skew which is solved by investment in the original arg and defending theory.

#### 2. Creates perverse incentives to collapse to theory instead of returning to substance- turns deterrence since theory over-proliferates which crowds out substance.

#### All interps aren’t counterinterps

#### Negate on presumption if they go for plantext in a vacuum – means that it isn’t an exclusive use no matter what

#### Constellations can be hundreds of satellites which proves other objects can be in the same orbit

Hidalgo (Sebastian Hidalgo, [Research Coordinator for Cloudflight], ND, “Why satellite mega-constellations could be a problem – Cloudflight“, Cloudflight, accessed: 1-29-2022, https://www.cloudflight.io/expert-views/why-satellite-mega-constellations-could-be-a-problem-47440/) ajs

The term mega-constellation describes a constellation consisting of several hundreds or thousands of satellites orbiting Earth

#### More evidence from astrophysicists:

Hainaut ND — (Olivier R .Hainaut, Astronomer, specialized in observations of distant minor bodies in the outer solar system. Twenty years of experience in developing and implementing challenging observation programs, in real-time optimization of the observations, in trouble-shooting and finding work-around or long-term solutions to hardware, software, scientific, operation problems ---from off-the-shelf to outside-the-box. Ten years of experience in operation management of observatories, including staffing, budget, scheduling, optimization of the operations. This includes dealing with staff from very broad multi-cultural origins, optimizing the assignments to staff capabilities and aspirations, resolving inter-personal and inter-departmental conflicts.. Five year experience in outreach and science communication, with emphasis on scientific correctness of the outreach products, and on the creation of top outreach astronomical images. Coordination of a network of communicators over 20+ countries. , “Large Satellite Constellations and their Impact on Astronomy“,Available Online at https://www.eso.org/~ohainaut/satellites/, accessed 3-22-2022, HKR-AR) // this article cites reports in 2022, but does not list a date on the website.

Wikipedia: "A satellite constellation is a group of artificial satellites working together as a system." A mega-constellation is a group of large constellation, with hundreds or thousands of individual satellites. The Starlink, OneWeb and others (see below for a list) aim at providing global telecommunication coverage, with a very low latency. The low latency implies a very low altitude, which in turns implies a very large number of satellites (see the visibility section below for details.

#### Reject their definition of LSC’s – its analyzing the orbital risk of LSCs, its not making an intrinsic claim as to what large satellite constellations constitute. Read their evidence

### 1NC

#### Interpretation – affirmative teams must defend legal action by a government

John Bouvier 56 [The Free Dictionary, “Unjust”] [DS] [https://legal-dictionary.thefreedictionary.com/Unjust#:~:text=UNJUST.,test%20of%20right%20and%20wrong.]

Unjust Also found in: Dictionary, Thesaurus, Wikipedia. Related to Unjust: Unjust enrichment UNJUST. That which is done against the perfect rights of another; that which is against the established law; that which is opposed to a law which is the test of right and wrong.

#### This is clear

Black’s Law Dictionary ND [DS] [https://thelawdictionary.org/unjust/]

UNJUST Contrary to right and justice, or to the enjoyment of his rights by another, or to the standards of conduct furnished by the laws.

#### “Resolved” means enactment of a law.

Words and Phrases 64 Words and Phrases Permanent Edition (Multi-volume set of judicial definitions). “Resolved”. 1964.

Definition of the word “resolve,” given by Webster is “to express an opinion or determination by resolution or vote; as ‘it was resolved by the legislature;” It is of similar force to the word “enact,” which is defined by Bouvier as meaning “to establish by law”.

#### Violation – the aff fiats private self-restriction, which is not a method of correcting injustice nor an enactment of a law.

#### Ground – generics on this topic must be tied to the actor, not the action, because each space appropriation is unique. A topic where the unifying thesis is countries legislating restrictions on space appropriation is much better than one about private actors self-restricting – their interp skirts multilat good/bad, K’s of IR and global governance, and CP’s to reform the OST – there are no unifying DA’s to different private companies around the world signing binding internal memos to restrict a type of space appropriation.

#### No RVIs – they’re illogical, create a chilling effect on setting theory norms, and destroy substantive education.

### 1NC

#### Counterplan:

#### Private entities in Asia should significantly invest in the exclusive use of Low Earth Orbit via Large Satellite Constellations for the purposes of emergency communications in the event of disaster relief or external shocks.

#### Private entities that engage in the exclusive use of Low Earth Orbit via Large Satellite Constellations should implement Collision Avoidance Procedures

#### All other private entities, except for those in Asia with the above purposes, should not engage in the exclusive use of Low Earth Orbit via Large Satellite Constellations. SpaceX, OneWeb, Google, Amazon, and Telesat should immediately halt their engagement in the exclusive use of Low Earth Orbit via Large Satellite Constellations.

#### Private entities that engage in the exclusive use of Low Earth Orbit via Large Satellite Constellations should substantially harden their cybersecurity by instituting the following measures: Multi check for IoT devices, Identity and Access Management, Intrusion Detection System, Immediate Kill-Switch of Satellites that’s required to activate when malicious, anomalous, or abnormal activity is detected, Supply Chain Risk Program, Independent Command Logging, Physical Separation of Network Components, Crisis Communication Plans, Machine Learning that detects abnormal activity, and Collision Avoidance Procedures

#### Private entities should ban rocket propellants that produce alumina particles in the stratosphere or deposit black soot in the stratosphere.

#### Private LEO constellations are economically viable in the long term, but require upfront investment – those uniquely solve disaster response because of satellite internet’s connectivity options for island countries

Garrity and Husar 21 Garrity, John, and Arndt Husar. John Garrity is an economist, policy advisor, and project manager focusing on digital inclusion, universal internet access policy, and last-mile connectivity. He has coauthored numerous reports on technology and development and has presented around the world on efforts to close the digital divide. Arndt Husar facilitates the effective use of digital technology, advising ADB clients, regional departments, as well as sector and thematic groups on digital transformation. " Digital Connectivity and Low Earth Orbit Satellite Constellations: Opportunities for Asia and the Pacific." (2021).

Satellite communication plays a necessary role in the global connectivity ecosystem, connecting rural and remote populations, providing backhaul connectivity to mobile cellular networks, and rapidly establishing communication in emergency and disaster response scenarios. This Asian Development Bank (ADB) Sustainable Development Working Paper, the first in a series reviewing emerging innovations in connectivity technologies, focuses on low Earth orbit (LEO) satellites, which have been in deployment for decades and are again a subject of intensive investment as new large constellations are in early stages of deployment. These new LEO constellations, such as those being deployed by Starlink by SpaceX, Project Kuiper by Amazon, OneWeb, Lightspeed by Telesat, among others, may prove to be transformational to the connectivity landscape based on their global coverage and their suitability for areas not served by fiber optic cable networks. ADB’s developing member countries are well placed to leverage and benefit from this expansion of internet connectivity, particularly for underserved geographies and countries with limited international internet bandwidth, such as landlocked developing countries and small island developing states. With their global reach and coverage, LEO constellations are expected to dramatically expand the availability of high-speed broadband internet access with levels of service that rival fiber optic cables in terms of speed and latency, and at significantly reduced price levels compared to traditional geostationary satellites. A proactive engagement with LEO solutions is likely to yield benefits as the relevant business models are still evolving. Well-informed early action by regulators and investors can ensure that developing member countries prepare for opportunities presented by the anticipated expansion of connectivity bandwidth. I. IntRoDUCtIon This Emerging Connectivity Innovations Case Study on SpaceX Starlink and low Earth orbit (LEO) satellite constellations is intended to provide readers, particularly in developing countries in Asia and the Pacific, with a background understanding of the role of satellite communications in global internet connectivity and an exploration of the potential impact of the next generation of LEO constellation systems. While the adoption of internet connectivity across the world has generally increased incrementally, some innovations have been transformational, dramatically expanding the geographic reach of connectivity and bandwidth capacity. For example, the introduction of basic mobile phones in the late 1990s and early 2000s led to rapid adoption of mobile telephony across low- and middle-income countries (a phenomenon known as the “mobile miracle”). Similarly, public and private investment in undersea fiber optic cables circling sub-Saharan Africa in the 2000s significantly reduced the cost of bandwidth in many countries in the region. Satellites have used low Earth orbits since the beginning of space exploration; however, private investment in LEO constellations, consisting of hundreds or thousands of satellites, has been limited because significant up-front capital expenditure is required. While it remains to be seen how the next generation of LEO satellite constellations will evolve, LEOs are forecasted to significantly increase the available internet bandwidth in remote and rural geographies not currently served by fiber optic cables. This increased bandwidth could be leveraged to increase economic and social development opportunities for individuals, organizations, businesses, and government facilities (including public schools) located in these areas, provided that the private sector satellite companies investing in LEO constellations see market opportunities to extend service to these areas. This case study is intended to introduce to Asian Development Bank developing member countries how to start preparing for the expansion of LEO satellite communication services. II. BACKGRoUnD: sAteLLIte ConneCtIVItY As A MeAns FoR BRoADBAnD InteRnet Internet connectivity has become a necessary component of every country’s critical infrastructure given the reliance of all aspects of economic activity, governance, and social development on internet communications. The coronavirus disease (COVID-19) pandemic dramatically increased the importance of internet communications infrastructure. Trade, employment, learning, leisure, and communications quickly shifted into the digital sphere and countries with robust internet infrastructure and high adoption rates of internet-enabled devices were better able to adjust and adapt to the shift to digital activity. The United Nations estimates that 1.6 billion learners were affected by school closures in 2020, affecting 94% of the world’s student population and up to 99% in low and lower middle-income countries.1 1 United Nations. 2020. Policy Brief: Education during COVID-10 and beyond. 2 ADB Sustainable Development Working Paper Series No. 76 Access to distance learning opportunities varies greatly by country and income groups, with estimates of less than half of students in low-income countries able to access distance learning.2 Internet access and adoption in the developing member countries (DMCs) of the Asian Development Bank (ADB) continues to grow, particularly as a result of public and private investment in telecommunications infrastructure, increased competition, and allocation of shared resources, such as spectrum auctions and assignment. Despite these efforts, large access gaps remain in Asia, where the most remote, difficult to reach, or sparsely populated districts remain disconnected, leaving more than half of the population without access to the internet. This lack of digital infrastructure represents a missed opportunity to accelerate economic and social development. Despite the rapid expansion of internet connectivity infrastructure across the world, significant gaps in internet adoption and infrastructure access remain. This highlights the importance of satellite communications that can bridge gaps, swiftly expand network coverage, and enhance existing infrastructure. The latest estimates from the International Telecommunication Union (ITU) show that 3.7 billion people are still not participating online (49% of the global population), and 63% of rural households are without internet access (Figure 1).3 Also, 1.5 billion people reside in areas without high-speed mobile data coverage (fourth generation long-term evolution or 4G LTE), while 607 million people reside in areas with no mobile data coverage at all (at least 4G or third generation [3G] coverage). Furthermore, 313 million people reside in areas with only basic voice and short messaging service (SMS) coverage (second generation [2G]), and 220 million people reside in areas with no cellular coverage. The ITU estimates that nearly $428 billion is required to achieve universal access to broadband globally, $251 billion of which is required for Asia, with approximately 75% coming from the private sector and the remainder with support from the public sector.4 The majority of the world’s population, over 5 billion people, live more than 10 kilometers (km) away from any fiber optic cable infrastructure (3.6 billion reside more than 25 km away).5 Other issues, such as affordability, digital literacy, and the lack of relevant or local language content, have resulted in 2.4 billion people who live within 4G coverage not subscribing to 4G data services. [FIGURE 1 OMITTED] Satellite connectivity is predominantly used for backhaul connectivity for remote cellular base stations and as a last-mile connection for individual subscribers and enterprises. Figure 2 provides an overview of the internet infrastructure network components, from international connectivity to the last mile. Because of the higher relative cost of bandwidth transmitted via satellite versus terrestrial technologies, satellite is currently primarily used in situations where fiber optic cables and other high-capacity technologies are not financially viable due to low population densities and large distances between high-capacity networks and last-mile networks.6 However, in a few cases, satellite connectivity is relied upon for international internet gateway traffic or as part of a country’s core network. For landlocked developing countries that are dependent on terrestrial fiber connectivity, in some cases, satellite connectivity serves as a substitute to complex bilateral and multilateral negotiations to extend costly fiber connectivity to their country. [FIGURE 2 OMITTED] Satellite connectivity is predominantly used for backhaul connectivity for remote cellular base stations and as a last-mile connection for individual subscribers and enterprises. Figure 2 provides an overview of the internet infrastructure network components, from international connectivity to the last mile. Because of the higher relative cost of bandwidth transmitted via satellite versus terrestrial technologies, satellite is currently primarily used in situations where fiber optic cables and other high-capacity technologies are not financially viable due to low population densities and large distances between high-capacity networks and last-mile networks.6 However, in a few cases, satellite connectivity is relied upon for international internet gateway traffic or as part of a country’s core network. For landlocked developing countries that are dependent on terrestrial fiber connectivity, in some cases, satellite connectivity serves as a substitute to complex bilateral and multilateral negotiations to extend costly fiber connectivity to their country. Particularly in situations where a high degree of data throughput is required per site, such as satellite backhaul for broadband cellular networks, the data volumes as well as the distance to the nearest backbone node play a significant role in cost comparisons between satellite connectivity versus terrestrial network deployments (microwave backhaul, in particular). Figure 4 illustrates how higher data bandwidth requirements are more cost-effectively supplied by terrestrial ground networks; however, a crossover point occurs where satellite capacity may end up being more cost-competitive, depending on different price points of satellite bandwidth and total traffic demand per month.12 Satellite connectivity is also well- suited to deploy in emergency situations, such as in response to natural disasters or other external shocks, that require expeditious deployment of network connectivity where terrestrial infrastructure is either nonexistent or destroyed. For many rural and remote communities, satellites are the only connectivity option. For geographies without direct access to fiber optic cable infrastructure or at great distances from high- capacity bandwidth capacity, satellite connectivity is the only option available. Even where terrestrial network infrastructure that could be used for backhaul connectivity is available, satellite deployments may still be preferred because satellite terminals require only electrical power and a clear line of sight to the sky. However, an expansion of terrestrial infrastructure usually requires extensive civil works (underground fiber ducts, pole attachments, or tower construction for cellular base stations), which comes with challenges such as securing the rights-of-way, permits, and having to pay the related fees. Satellite broadband is poised to become an even more important technology for addressing the growing digital divide. As information and communication technologies play an increasingly important role in commerce, government services, health care, education, and other sectors, satellite connectivity allows communities to get connected swiftly, bypassing the infrastructure deployment challenges that come with terrestrial infrastructure deployments. The role of satellite connectivity in emergency telecommunications has also been vital where the communications satellites are heavily relied upon in disaster recovery efforts.13 Satellite technology may also be complementary with traditional wired and mobile broadband, which are better suited for densely populated areas. Satellite service could become a default solution for remote areas, allowing terrestrial services to focus on improving access in their current coverage areas. Satellite connectivity is already being used for network redundancy at national levels for international internet capacity, as well as for backup in core and backhaul networks.14 The recent $50 million loan to Kacific by ADB for the deployment of a broadband satellite, which covers large parts of Southeast Asia and the Pacific, demonstrates the relevance of satellite connectivity for unserved and underserved regions.15 By deploying new satellite technology (in the Ka-band16), Kacific’s service offering is commercially viable despite the existing presence of other major competitors in Asia and the Pacific, including global entities such as Intelsat, SES, and Eutelsat, as well as more regional players such as AsiaSat, Thaicom, MEASAT, and SKY Perfect JSAT.

#### Starlink makes fast internet globally accessible

Crist 22 – [Ry, CNET, “Starlink explained: Everything you should know about Elon Musk's satellite internet venture,” 1/10/2022, https://www.cnet.com/home/internet/starlink-satellite-internet-explained/]

Starlink's business is accelerating, as well. In February of 2021, Musk's company disclosed that Starlink was serving more than 10,000 customers. Now, after expanding preorders to even more potential customers, releasing a second-gen home internet satellite dish, and exploring the possibility of providing in-flight Wi-Fi for passenger aircraft, Musk says that Starlink has shipped more than 100,000 satellite internet terminals to customers in 14 countries.

During a talk at Mobile World Congress in June 2021, Musk told an audience that Starlink would be available worldwide except at the North and South Poles starting in August, though regional availability will depend on regulatory approval. In September, Musk tweeted that Starlink would exit its initial beta phase in October, which indicates that the service is continuing to ramp up and expand -- though the budding broadband provider faces a backlog of prospective customers waiting to receive equipment and start service.

Starlink isn't without its controversies. Members of the scientific community have raised concerns about the impact of Starlink's low-earth orbit satellites on night sky visibility. Meanwhile, satellite internet competitors including Viasat, HughesNet and Amazon's Project Kuiper have taken notice of Starlink's momentum, too, prompting plenty of regulatory jousting and attempts to slow Musk down.

We'll continue to monitor Starlink's progress in 2022. For now, here's everything you should know about it.

OK, start at the beginning: What is Starlink, exactly?

Technically a division within SpaceX, Starlink is also the name of the spaceflight company's growing network -- or "constellation" -- of orbital satellites. The development of that network began in 2015, with the first prototype satellites launched into orbit in 2018.

In the years since, SpaceX has deployed nearly 2,000 Starlink satellites into orbit across dozens of successful launches, the most recent of which took place on Jan. 6 and delivered another 49 satellites into orbit. That brings the total number of satellites in the constellation up to 1,993, though some of those satellites are prototypes or nonoperational units that aren't functioning parts of the network.

And those satellites can connect my home to the internet?

That's the idea, yes.

Just like existing providers of satellite internet like HughesNet or Viasat, Starlink wants to sell internet access -- particularly to people in rural areas and other parts of the world who don't already have access to high-speed broadband.

"Starlink is ideally suited for areas of the globe where connectivity has typically been a challenge," the Starlink website reads. "Unbounded by traditional ground infrastructure, Starlink can deliver high-speed broadband internet to locations where access has been unreliable or completely unavailable."

#### The Asia-Pacific is the most disaster-prone region in the world – the next catastrophe is a question of when, not if

Thomas Bickford et al 15, Ph.D., senior research scientist in CNA Corporation’s China Studies division, “The Role of the U.S. Army in Asia,” May, https://www.cna.org/CNA\_files/PDF/CRM-2015-U-010431-Final.pdf

Natural disasters As Typhoon Haiyan amply demonstrated when it hit the Philippines in November 2013, natural disasters can represent a significant threat to human security. In 2012, the Asia-Pacific region experienced 93 natural disasters, which affected some 75 million people.206 It is one of the most disaster-prone regions in the world:207 it is prone to typhoons and cyclones; it contains some of the world’s most active faults and volcanos; and many areas experience massive flooding. As former USARPAC commander Lieutenant General Wiercinski has noted, the only questions are when and where the next big disaster will occur. Admiral Locklear, Commander, USPACOM has noted that climate change is one of the region’s most pressing security challenges.209 While the ability to respond to natural disasters varies widely among countries in the region, even advanced countries can require international assistance, as Japan did after the March 2011 earthquake and tsunami.

#### Natural disasters are an existential threat – but increased preparation solves – outweighs all other risks

Anders **Sandberg 18**. Future of Humanity Institute, University of Oxford. 02/26/2018. “Human Extinction from Natural Hazard Events.” Oxford Research Encyclopedia of Natural Hazard Science. oxfordre.com, doi:10.1093/acrefore/9780199389407.013.293.

Systemic Risks

**Localized** disasters or slow-moving risks are unlikely **on their own** to spell doom for H. sapiens. It may appear that an unlikely intense global event or confluence of disasters need to occur in order to cause extinction. **However**, many risks are potentially **systemic**: a **sequence** or **combination** of disasters may **reduce resiliency** and the ability to **recover**, especially when interacting with the **human systems**. A model of how compound risks can act is the synchronous failure model of Homer-Dixon et al. (2015). **Multiple stresses** (such as climate change, resource shortages, or conflicts) can **interact** and **accumulate** in a social-ecological system, **pushing** **it** **to**ward a state where its **coping capacity** is **diminished**. Different sub**systems** become **coupled** because they require support from each other to function in the stressed state. When a **crisis occurs** (either externally triggered or because an internal component finally fails) it **rapidly cascades through the system**, spreading between subsystems and causing the **whole to fail**. Simultaneous damage is often **multiplicative in severity**. Many **human systems** such as **food, energy, finance and comm**unication**s** are **global**, densely interconnected systems where failures can **cascade** **rapidly** (Helbing, 2013). They have **developed** in a locally rational way: the gains in efficiency and reliability have been significant. However, the probability of global failures also has **increased** compared to more local, modular and redundant systems (Goldin & Vogel, 2010). While societal collapse does not imply extinction, humans are **dependent** on complex societies and their high productivity, and **any** long-term **collapse** would **reduce the human carrying capacity significantly**. A stressor such as **climate change** may **increase** the probability and severity of global failure, and once this occurs **vulnerability to further risks increases**. Various example scenarios can be constructed where plausible events produce gradual deterioration of the human system before it can recover; see, for example, Tonn and MacGregor (2009) and other papers in the same issue. Another example is sudden geoengineering cessation. If, as a response to climate change, solar radiation management geoengineering is used to maintain temperature, this will require ongoing technological maintenance. If a global disaster disrupts civilization, besides the damage from the primary disaster there would also be a rapid temperature change to close to what the un-modified climate would have been. This will likely produce massive **disruptions of ag**riculture and other human systems at the time when **vulnerability is maximal** (Baum, Maher, & Haqq-Misra, 2013). In this case a risk mitigation effort adds to systemic risk. Systemic effects are **hard to predict** (trade can both strengthen human societies by providing an adaptive system of distribution, prosperity, and incentives for innovation as well as destabilize them due to market bubbles, dependencies, and spread of pathogens). Taking uncertainty into account is possible but tends to lead to conservative policies (Weitzman, 2009). Another approach is to engineer human systems so they are naturally redundant, modular, and otherwise resilient to systemic stresses (Helbing, 2013). Probabilities Estimating existential risks can be done in many ways, each with their own merits and drawbacks; see (Tonn & Stiefel, 2013) for a review. It is possible to place upper bounds on extinction risks due to natural disasters by considering the fossil record. This can be done in several ways; the following will be based on the work of Toby Ord (2017). The simplest bound is based on the observation that H. sapiens has existed for 200,000 years: this observation would be unlikely if the extinction risk was higher than about 1 in 3,000 per century. One can say that an extinction rate of 0.15% or higher per century is ruled out at a 95% confidence level. Another bound uses now-extinct related hominin species as a reference class, producing estimates in the range 0.001% to 0.05% per century. This is in line with survival times for mammalian species, which typically is 1–2 million years (Raup, 1978) but shorter than for the entire fossil record where lifetimes of 5–10 million years are typical (Raup, 1986; May, Lawton, & Stork, 1995). H. sapiens is an unusually populous, well-dispersed, and adaptable large mammal species. However, it also has high food requirements and a long generation time. It may then be that the most likely risk to lead to extinction would be a mass-extinction level risk. Large mass extinctions occur at a rate of about 1 in 100 million years, producing a risk estimate of 0.0001% per century. One issue is that we are still discovering new kinds of existential risks. As noted above, supernovas have been recognized as a risk since the 1950s but gamma ray bursts were recognized as a risk first in the 1990s. High-energy physics risks were suggested in 1970s and later. Recognition of supervolcanism as a risk dates to the 1990s, in turn based on the models of nuclear winter in the 1980s. “Big rip” early endings of the universe were noticed in 2003 (Caldwell, Kamionkowski, & Weinberg, 2003). Since the rate of discovery does not seem to have slacked off, it is plausible that more natural hazards exist that we are unaware of, yet could pose a threat. At the same time, the above estimates bound the total risk: we are merely refining our understanding of what hazard categories exist. It should be noted that using past geological or fossil records to estimate risks that could have influenced the emergence of the species doing the risk estimation requires some care: risks that would have precluded the emergence of the species would naturally be underrepresented (Ćirković, Sandberg, & Bostrom, 2010). It is also clear that the peculiarities of the current situation may exacerbate some risks (e.g., pandemics) while reducing others (e.g., local disasters); these estimates merely show the risk magnitude for the earlier stages of the species’ history. The current probability is dynamically changing depending on human action. Probability estimates are on their own irrelevant: the point of risk assessment is to motivate rational risk management. This includes prioritizing mitigation efforts (typically toward the largest, most urgent, and most controllable risks) and research to reduce uncertainty and find more options. Mitigation Human extinction is an unusual risk since it can only occur once. Mitigation efforts need to succeed every time. Mitigating extinction risk can be done by reducing the probability of sufficiently severe hazards occurring, improving resilience mechanisms to reduce the damage, and endurance mechanisms to ensure that survivors can rebuild and repopulate. Many astrophysical extinction risks, supervolcanism and the emergence of new diseases are likely impossible to prevent, requiring resilience strategies. Impacts from near earth objects or comets can in principle be prevented given enough lead time and the right technological level (NRC, 2010). The amount of impulse needed to avoid an earth collision scales inversely with the lead time and proportional to the impactor mass: with enough time, even a high-precision weak intervention can move large objects. Managing atmospheric emissions and possibly intervening with geoengineering can influence climate risks (Wigley, 2006; Moreno-Cruz & Keith, 2013). Human systems can be designed to be resistant to various forms of systemic risks (Helbing, 2013). Prediction of extreme events is often impossible since they are the outcome of cascades in noisy, chaotic systems with hidden variables, and past data of less extreme cases often does not constrain models of phenomena of this magnitude. This requires using robust strategies taking large uncertainty into account (Weitzman, 2009). Although exact prediction may not be possible, rapid and improved response is possible and can enhance the resiliency against many of the listed threats. This includes better risk surveillance, preparation of responses and resources, as well as intergovernmental coordination. Many extinction risks have joint pathways. For example, supervolcanism, large meteor impacts, and nuclear winters (not discussed in this article) do most of their harm by precluding agricultural/fishing over a span of years leading to widespread starvation (Engvild, 2003). While they also cause other harms this particular shared pathway can be dealt with by emergency food stores or alternative food sources (Denkenberger & Pearce, 2014). Shielding in space against radiation sources could in principle mitigate the risk from supernovas, GRBs, superflares, and similar risks (Ćirković & Vukotić, 2016). Improved resiliency against particular damage pathways can hence improve chances against a large set of risks. Endurance mechanisms aim at ensuring survival, adaptation, and eventual recovery after a near-extinction disaster (Maher & Baum, 2013). An occasionally suggested endurance mechanism against extinction risks is the deliberate construction of refuges where people can survive (or the encouragement of natural refuges in isolated regions, nuclear submarines etc.). Ideally such refuges would be self-sufficient and independent of the earth’s surface (Baum, Denkenberger, & Haqq-Misra, 2015; Jebari, 2015). However, refuges only help against certain categories of disasters and their cost-effectiveness depends on the relative value of current and future generations (Beckstead, 2015). Undersupply of Mitigation Preventing extinction is important; **at least** as important as saving the lives of 7.2 billion people, and quite possibly **far more important** when taking future generations and their value into account (Parfit, 1984; Bostrom, 2003; Bostrom, 2013; Häggström, 2016). **Mitigating** extinction risk is an **undersupplied global public good**. For example, traditional statistical life valuations suggest that a $16–$32 billion annual investment in asteroid defense would be cost-effective yet U.S. government spending on asteroid detection (with no mitigation) is around $4 million per year, orders of magnitude smaller than funding for hazardous waste sites per unit of risk (Gerrard, 2000; Matheny, 2007). The annual cost to the world due to pandemic influenza has been estimated to $570 billion per year or 0.7% of global income, comparable to estimates of the long-term costs of climate change (Fan, Jamison, & Summers, 2016): the global influenza vaccine market has been estimated to less than $4 billion per year (Kaddar, 2013). These estimates merely take lives saved into account, not the value of future generations. Since existential risk mitigation is non-excludable and non-rivalrous there is a free-rider problem (non-participants gain the benefit without having to pay) and each producer of risk reduction would only gain a fraction of the total benefit. This is amplified by the transgenerational nature of risk reduction: most of the benefit will accrue to future generations. In principle the value to them of our present preventing extinction is near-infinite, but they cannot pay us any compensation (Matheny, 2007; Bostrom, 2013). Beside the normal logic of undersupply and lack of global coordination mechanisms there are also **cognitive** and **cultural** factors making existential risk mitigation rare. Part of the problem may be discomfort with the topic leading to willful denial or ignorance (Epstein & Zhao, 2009). Part of the problem is the difficulty to fit the topic with human **cognitive biases** (Yudkowsky, 2008; Wiener, 2016). Humans have **heuristics** that provide quick and adequate answers for many situations but lead to **systematic biases** in many situations removed from our ancestral everyday ones. For example, since extinction has not occurred in the past, the **availability heuristic** (“probabilities of events are roughly proportional to how easy examples of past events come to mind”) will underestimate likelihood. **Scope neglect** makes us relatively **insensitive** to the **number of lives** affected, making the willingness to make an effort scale sublinearly with the size of the problem. In general, without rich context information people are generally bad at judging differences between low probability events (Kunreuther, Novemsky, & Kahneman, 2001). Risks are judged not just by probability and severity but also by psychological aspects such as outrage and dread (Slovic, 1987). This can sometimes support efforts to mitigate global risks (since they tend to score highly on dread) but makes the focus strongly dependent on what is and is not discussed in public (Yudkowsky, 2008). This makes constructing risk management strategies that are resistant to behavioral biases vitally important for extreme risks (Kunreuther & Heal, 2012; Wiener, 2016). Conclusion There is **clear ev**idence that **natural events could cause** **the** **extinction** **of H. sapiens**. While astronomical risks may be the most dramatic, geophysical risks to food security and pathogenic risks appear to be more significant. It is unlikely that a **single disaster** will be severe enough to directly cause extinction, but it is plausible that it could place the species in **a vulnerable situation** for a long time, during which **other risks** could lead to **further vulnerability and** **extinction**.

#### That outweighs their impacts of nuclear winter – its junk science

Walker 18 (Robert Walker, first class honours degree in Math from York university, PhD at Wolfson College Oxford, 2018, "Debunked: Nuclear Winter and Radioactive Fallou...," https://debunkingdoomsday.quora.com/Debunked-Nuclear-Winter-and-Radioactive-Fallout-myths)

**There are many online pages and websites that seem very authoritative that say that even a limited nuclear war, say between India and Pakistan, would plunge the Earth into** a ‘Nuclear winter’ with no crops able to grow, no plants, no animals, and people soon starving to extinction. **This** is politically motivated and based on **out of date or** junk science. I am very much in favour of nuclear disarmament so I’m strongly in favour of the political views that motivate these people. I go so far as to argue that the UK should disarm unilaterally, and should never use its nuclear weapons under any circumstances. This is a similar view to the Scottish National Party and Jeremy Corbyn though he has not persuaded his party to adopt this stance, see my [Is Corbyn Right About The Bomb?- Op Ed](http://www.science20.com/robert_inventor/is_corbyn_right_about_the_bomb_op_ed-180465). But I think people need to know the truth and make decisions based on truth. I think it is important to speak up when a view is widely publicized that just about all scientists believe to be false, based on poorly supported research that they think will lead politicians to desired actions. Even if it has good political effects. In this case as well, **it is** also scaring **people** unnecessarily **who are afraid that even a small nuclear war could plunge us all into a deep freeze. No, it would not, and the** research suggesting this is **fundamentally** flawed and based on out of date ideas**. The** expert scientists **involved are sure** **that the** older nuclear winter models were incorrect, based on their failed predictions for the Kuwaiti oil fires **which they predicted would harm agriculture over much of** Asia but it only had local short term effects. There were many who were skeptical all along, but that was what persuaded nearly all of the ones who still thought it was possible that their models were wrong. There is one notable remaining nuclear winter proponent, Robok, who along with various co-authors publishes articles that are widely publicized because of their dramatic conclusions. However these predictions are not only not well received by other climate researchers, they are generally regarded as incorrect due to fundamental flaws in the assumptions his models are based on. The researchers who say this make assumptions that they can't prove and that everyone else in the field has said long ago don't work. **Carl Sagan gave up on the nuclear winter hypothesis after the Kuwaiti oil field fires and just about everyone else** except Robok **agreed with him.** SUMMARY The nuclear winter predictions date back to some predictions in the 1970s based on their limited crude models on slow computers (by modern standards) with hardly any memory, just kilobytes. They tried to model what would happen to the soot from fires in cities during a nuclear war. They concluded that it would be lofted so high into the atmosphere that it would get above all the normal weather and linger there for a decade, nearly blocking out the sun completely world wide. Their predictions were so dramatic that a 'nuclear winter' is an understatement. Average world temperature -25 C. You are talking about the ocean freezing even right to the tropics, for ten years. It's no wonder that they gave it that name. It had the support by highly respected scientist. One of the authors of the original paper was Carl Sagan. But the models were based on flawed assumptions**. Even at the time they were questioned. Nowadays just about all scientists involved, including ones that supported the hypothesis originally, are** **agreed that it would have little effect**. **It might** no effect on temperature **at all,** **except for a brief reduction of temperature** **locally during the fire itself as it turns day to night temporarily - since after all we have** large areas burnt in wildfires **every year with no effect.** The **scientists who did the nuclear winter work realized they had made a mistake in the modeling after the Kuwaiti oil fires**. **When the oil fields were left burning by the retreating troops, they predicted dire consequences for agriculture througout Asia. Instead it** **shaded out a** small part **of the gulf area** **with a** slight reduction of temperature **(similar to night time) for the duration of the fires** (several months). This showed that there was something wrong with their models. After looking into it in more detail **they decided that the** **soot** **doesn't rise nearly as high as they predicted in the atmosphere, and it** **tends to get** washed out within days **by rain.** The combined effect is that the darkening is temporary and local instead of long term and global. So, nearly all scientists agreed on this, but **Alan Robock published a paper in Physics Today in which he claimed that an all out exchange between Pakistan and India, of, say, 100 nuclear weapons would cool the Earth on average by a few degrees. The** **science in this paper** **was good except that he** started it already pre-loaded with soot **in the upper atmosphere**. Remember the very reason the early models got discredited is because soot doesn’t rise as high as expected in the Kuwaiti oil fires. Nor does it with wildfires or the fires from the Dreden bombing - and Hiroshima and Nagasaki didn’t have fire storms at all. This paper doesn’t even discuss this question. **It simply pre-loads the atmosphere with soot in the upper atmosphere, and from then on it follows the consequences.** **But that is the very point at contention** - **whether the soot would end up so high in the atmosphere.** **Everyone is agreed that there would be serious consequences if this happened but the evidence is that** it can’t get there **after the fires started in a nuclear war.**

#### solves ozone depletion

Mortillaro 21 (Nicole Mortillaro, Senior Reporter, Science, She is the editor of the Journal of the Royal Astronomical Society of Canada and the author of several books., 4/22/21, Canadian Broadcasting Corporation, “Rocket launches could be affecting our ozone layer, say experts”, <https://www.cbc.ca/news/science/rocket-launches-environment-1.5995252>, Accessed 1/27/22, HKR-RKT)

Black soot in the atmosphere The stratosphere is an important weather driver for Earth's systems, and that's where some particles from rocket launches are ending up. The ozone layer, which helps protect us from the sun's harmful ultraviolet rays, is also located in the stratosphere. In 1990, the Montreal Protocol was signed into law, banning harmful ozone-depleting substances, such as chlorofluorocarbons (CFCs), used in things like refrigerators and air conditioners, after it was revealed that the ozone layer was being stripped away by these chemicals. While the protocol touched on airlines, there was no mention of the aerospace industry. But now some industry experts are concerned that with no oversight, we could be in for a problem. There are different types of rocket propellants. Some, like liquid oxygen and liquid hydrogen, produce mainly water vapour and have little environmental impact. These were used in past shuttle launches and even in the Apollo-era Saturn V vehicles. Then there are those that produce alumina particles in the stratosphere, such as those in solid rocket boosters, which were also used in past shuttle launches, and are still being used today by some launch companies. Finally, there are those that deposit black soot in the stratosphere, such as kerosene used in SpaceX's Falcon 9 and Russia's Soyuz rockets. It's the alumina and black soot that is most concerning to experts.

#### Collision avoidance solves

Arif 17 — (Aayesha Arif, Journalist, “This Is How Satellites Avoid Colliding Into Each Other“, Wonderful Engineering, Available Online at https://wonderfulengineering.com/satellite-collision/, accessed 3-22-2022, HKR-AR)

A standard collision avoidance procedure has been established by space agencies to avoid any such accident. Every time a satellite is launched, a Collision On Launch Assessment (COLA) is performed. To make sure that the space vehicle trajectory does not take it too close to any other object in space, the launch window is set such that it has COLA blackout period, the intervals during which the spacecraft does not lift.

The purpose of COLA is to avoid the collision after launch. To avoid any debris or spacecraft collision while in orbit, the satellite performs collision avoidance maneuver also called Debris Avoidance Maneuver (DAM). The collision avoidance maneuver is usually performed to raise or lower the orbit of the craft by a few kilometers. Read more about how the Hubble Space Telescope conducts it to avoid space debris hits.

#### Solves the case

Brooks 22 — (Chuck Brooks, President of Brooks Consulting International, is a globally recognized thought leader and subject matter expert Cybersecurity and Emerging Technologies. Chuck is also Adjunct Faculty at Georgetown University’s Graduate Applied Intelligence Program and the Graduate Cybersecurity Programs where he teaches courses on risk management, homeland security, and cybersecurity. LinkedIn named Chuck as one of “The Top 5 Tech People to Follow on LinkedIn.” He was named as one of the world’s “10 Best Cyber Security and Technology Experts” by Best Rated, as a “Top 50 Global Influencer in Risk, Compliance,” by Thompson Reuters, “Best of The Word in Security” by CISO Platform, and by IFSEC and Thinkers 360 as the “#2 Global Cybersecurity Influencer.” He was featured in the 2020, 2021, and 2022 Onalytica "Who's Who in Cybersecurity" – as one of the top Influencers for cybersecurity. He was also named one of the Top 5 Executives to Follow on Cybersecurity by Executive Mosaic, He is also a Cybersecurity Expert for “The Network” at the Washington Post, Visiting Editor at Homeland Security Today, Expert for Executive Mosaic/GovCon, and a Contributor to FORBES. He has an MA in International relations from the University of Chicago, a BA in Political Science from DePauw University, and a Certificate in International Law from The Hague Academy of International Law., “The Urgency To Cyber-Secure Space Assets“, Forbes, 2-27-2022, Available Online at https://www.forbes.com/sites/chuckbrooks/2022/02/27/the-urgency-to-cyber-secure-space-assets/, accessed 3-22-2022, HKR-AR)

2. Identity and access management (“IAM”) – those accessing flight control information and surfaces need to be identified and verified by an IAM solution that will pass muster on the user using machine learning identifiers to attempt to prevent authorized access to critical vehicle functions.

3. Multi check for IoT related devices – IoT devices must be able to be updated; no hard-coded passwords should be allowed.

4. The backbone of a cyber-resilient spacecraft should be a robust intrusion detection system (IDS). The IDS should consist of continuous monitoring of telemetry, command sequences, command receiver status, shared bus traffic, and flight software configuration and operating states, anticipate and adapt to mitigate evolving malicious behavior. The spacecraft IPS and the ground should **retain the ability to return critical systems** on the spacecraft to known cyber-safe mode. Logging should also be available to cross-check for anomalous behavior.

5. It is critical that spacecraft developers implement a supply chain risk management program. They must ensure that each of their vendors handles hardware and software appropriately and with an agreed-upon chain of custody. Critical units and subsystems should be identified and handled with different rigor and requirements than noncritical units and subsystems and should also be constructed with security in mind. All software on the spacecraft should be thoroughly vetted and properly handled through the configuration management and secure software development processes (DevSecOps).

6. Both the spacecraft and ground should independently perform command logging and anomaly detection of command sequences for cross validation. Commands received may be stored and sent to the ground through telemetry and automatically checked to verify consistency between commands sent and commands received.

7. Protections should be made against communications jamming and spoofing, such as signal strength monitoring and secured transmitters and receivers; links should be encrypted to provide additional security.

Security elements for defending ground-based systems and network assets include but are not limited to (also from the Homeland Security Today article):

1. Adoption of cybersecurity best practices, including those aligned with the NIST cybersecurity framework (“CSF”). As academic professors and pragmatists, we both are ardent supporters of the CSF and see no reason why the hundreds of space and satellite suppliers should not adopt the NIST framework.

2. Key network components should be logically and physically separate to prevent virus-like (ransomware) attacks from spreading throughout the network.

3. All ground-based system and network assets should be required to have the following policies in place: incident response, business continuity and crisis communications plans, patching policies, BYOD policies and backup policies.

4. All ground-based space systems and facilities should be required to hold quarterly employee training for all individuals on things like spear-phishing and socially engineered email attacks.

5. All ground-based space systems and facilities should be required to adopt a fulsome vendor supply chain risk management program that touches all primary and tertiary vendors.

6. All ground-based space systems and facilities must adopt machine learning intrusion detection systems to help guard against anomalous and potential malicious activity.

7. All ground-based space systems, facilities, and space manufacturers and vendors should be required to join the Space ISAC to be able to collaborate by sharing threats, warnings, and incident information.

### 1NC

#### Commercial megaconstellations solve communication deserts and intel shortages – that’s key to military dominance and forward deployment in the Arctic, East Asia, and Eastern Europe. Independently, it solves missile threats to precision strike systems.

Hallex and Cottom 20 — (Matthew A. Hallex, Research Staff Member at the Institute for Defense Analyses, Travis S. Cottom, a Research Associate at the Institute for Defense Analyses, “Proliferated Commercial Satellite Constellations: Implications for National Security”, JFQ 97, 2nd Quarter 2020, Available Online at <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97_20-29_Hallex-Cottom.pdf?ver=2020-03-31-130614-940>, accessed 1-30-22, HKR-AM)

The emergence of proliferated constellations will lead to easier access to satellite communications, space imagery, and other capabilities that can support U.S. and adversary military operations in the ground, maritime, and air domains. Adapting to these changes will likely require the development of new joint operational concepts to better exploit space systems in support of the joint fight as well as address new force protection challenges when fighting space-enabled state and nonstate actors. Proliferated constellations will substantially increase the availability of communications bandwidth for military operations. These satellites would provide high bandwidth to forces with less latency than existing GEO satellites,32 which, in turn, would improve access to reachback communications to forward-deployed military forces, and would also help meet the growing demand for transfer capacity for data collected by unmanned systems and other forward sensors. Proliferated LEO communications constellations would also offer coverage in theaters that are poorly served by commercial satellite communications today. Satellites in GEO do not sufficiently support **operations in the Arctic** and other high-latitude regions that are growing in economic and national security importance.33 Similarly, naval and air forces **operating in the Pacific** theater have less access to commercial communications than other theaters due to the lack of commercial customers in the open ocean. Proliferated commercial LEO constellations would provide greater communications handling in both regions because of their global coverage. While unable to provide the high-resolution imagery and other specialized capabilities of existing national security satellites, proliferated LEO constellations could help to address some of the intelligence challenges the U.S. military faces. During the first Gulf War, the United States was unable to track and target Iraq’s Scud missile systems despite enjoying almost total air superiority. Since then, mobile missiles and other elusive targets have multiplied as potential adversaries seek to defeat U.S. conventional precision and nuclear strike systems. Imagery proliferated constellations could provide continuous or near-continuous coverage of missile operating areas to better enable the United States to find and eliminate these threat systems. The near continuous imagery coverage proliferated constellations offers—particularly if they include radar satellites that can see through clouds— combined with ground processing capabilities that can automatically detect changes in imagery would also make adversary deception operations less effective.34 Because the United States is likely to be on the defensive in the most worrying scenarios for conflict—such as **defending allies in Eastern Europe or East Asia**—these new capabilities will support U.S. efforts to detect adversary mobilization and to avoid operational surprise.

#### The US needs the private sector

Hallex and Cottom 20 — (Matthew A. Hallex, Research Staff Member at the Institute for Defense Analyses, Travis S. Cottom, a Research Associate at the Institute for Defense Analyses, “Proliferated Commercial Satellite Constellations: Implications for National Security”, JFQ 97, 2nd Quarter 2020, Available Online at <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97_20-29_Hallex-Cottom.pdf?ver=2020-03-31-130614-940>, accessed 1-30-22, HKR-AM)

The U.S. Government has been the largest and most stable customer for commercial satellite imagery, including resources from new imagery proliferated constellations. For instance, a significant share of Planet’s growth has been through multiple contracts with the National Geospatial-Intelligence Agency.12 Commercial Earth observation companies, however, are seeking to diversify their customer base and reach new markets—to rely less on U.S. Government spending and, consequently, to potentially reduce its sway over commercial actors. With lower prices and increasingly on-demand imagery services, proliferated constellation companies are trying to focus on new, nontraditional satellite imagery markets: industrial monitoring, agriculture, utilities, marine transportation analytics, insurance, resource management, business intelligence, and other data-driven, decisionmaking practices.13 This broader range of services will help drive market expansion, and the Institute for Defense Analyses’ Science and Technology Policy Institute projects the overall commercial small satellite imaging market will grow from $15 million in 2015 to $164 million in 2020.14

#### China will launch public megaconstellations no matter what which thumps the aff BUT the US needs the private sector to stay in the game

Hallex and Cottom 20 — (Matthew A. Hallex, Research Staff Member at the Institute for Defense Analyses, Travis S. Cottom, a Research Associate at the Institute for Defense Analyses, “Proliferated Commercial Satellite Constellations: Implications for National Security”, JFQ 97, 2nd Quarter 2020, Available Online at <https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-97/jfq-97_20-29_Hallex-Cottom.pdf?ver=2020-03-31-130614-940>, accessed 1-30-22, HKR-AM)

Interest in proliferated constellations is not confined to the United States and Western commercial space actors—both China and Russia are pursuing their own proliferated constellation projects. The development of foreign proliferated constellations will allow not only their owners to access these capabilities, but potentially access also to a wider range of actors. Given China’s willingness to allow for commercial dealings with countries hostile to the United States, these systems could pose a significant threat to U.S. interests. The state-owned China Aerospace Science and Technology Corporation (CASC) is planning the 300-satellite Hongyan LEO broadband communications proliferated constellation, and the state-owned China Aerospace Science and Industry Corporation plans its own 156-satellite Xingyun communications constellation. The first Hongyan satellite was launched in late 2018, and CASC has established a factory in Tianjin capable of producing 130 satellites a year. In 2015, China launched the first of its Jilin commercial imagery satellites to complement the Gaofen civil imagery constellation. The Jilin constellation is planned to reach 60 satellites by 2020 in order to provide global, 30-minute revisit rates, and then 138 satellites by 2030 to obtain 10-minute revisit rates worldwide.15

#### China will launch which takes out aff solvency, maintaining US dominance is key

Chaturvedi 1/29 (Amit Chaturvedi, [Hindustan Times, New Delhi, ], 1-29-2022, “China plans 'megaconstellation' of 13,000 satellites, claims report“, Hindustan Times, accessed: 1-30-2022, https://www.hindustantimes.com/world-news/china-plans-megaconstellation-of-13-000-satellites-claims-report-101643421318766.html) ajs

China is embarking on a mission that has renewed concerns about spying. It plans to send upto 13,000 satellites in space - a ‘megaconstellation’ - that will encircle the Earth in the lower orbit, a report in the Daily Mail said.

The company that has got the responsibility of this work has said that the main goal of the mission is to establish supremacy in lower Earth orbit, the report further said.

Strengthening of 5G network is the aim: China

China's State Administration of Science, Technology and Industry for National Defense (SASTIND) has called for orderly development of small satellites, according to the Daily Mail report.

It said that the group of satellites will be able to provide surveillance over much of the Earth and strengthen internet facilities.

#### solves nuclear war

Binnendijk 16 (Hans Binnendijk, Ph.D. in international affairs, Tufts University, senior fellow at the Center for Transatlantic Relations at SAIS, “Friends, Foes, and Future Directions: U.S. Partnerships in a Turbulent World Strategic Rethink,” Santa Monica, CA: RAND Corporation, 2016)

Today, the most important external challenge faced by the United States is the reemergence of potential confrontation between great powers and with rogue states. The United States now faces a risk of conflict with several potential adversaries: Four are nation-states with nuclear weapons or nuclear ambitions (Russia, China, North Korea, and Iran) and one is a diverse group of Salafi jihadists. Currently, the United States is engaged in military action against a wannabe state, the Islamic State of Iraq and Syria (ISIS).1 Most of these potential adversaries also cooperate with at least one other hostile nation, compounding the challenge for the United States. This is a fundamental change from the previous decade, when the focus of U.S. national security policy was on two stability operations in the greater Middle East, nonstate actors, and transnational threats. Those threats still exist, but a new set of challenges from nuclear states and nuclear aspirants is of greater concern. There are dramatic differences among these potential adversaries in terms of their ability to threaten vital U.S. interests and the extent to which their goals overlap with Washington’s. As a result, the United States must design a set of flexible and differentiated policies to deal with each potential foe. The overall goal should be to reduce these threats and the prospect of close cooperation among adversaries to challenge U.S. interests. To do this, the United States needs to quickly defeat ISIS, deter North Korea, dissuade Russia, constrain Iran, and engage China. These potential adversaries have created situations in which a large number of U.S. allies and partner nations are more vulnerable today than they were a decade ago. Many U.S. friends are in more danger than the United States is itself, and if the United States should be drawn into conflict with any of these adversaries (as it has already been drawn into conflict with ISIS), it will probably be to defend its partners more than itself. The principal risk to the United States is that conflicts with any of these adversaries could escalate. Involvement by the three nuclear powers (Russia, China, or—to a lesser degree— North Korea) could pose existential risks. While its partners remain a major U.S. asset that its adversaries do not enjoy to the same degree, many of those partnerships do present problems. Many partners are only slowly waking up to these changing international circumstances and have not yet taken up an adequate share of the global defense burden. Some partners do not fully share many of the United States’ values or interests and require flexibility in the relationship. And the most-vulnerable partners will need to work more closely with the United States to coordinate policies and crisis management plans in advance so that the United States will not be drawn into unforeseen conflict against its will. As the United States prepares to deal with adversaries and to help defend partners, it is at risk of becoming overextended. U.S. national security resources are shrinking as its challenges are expanding. U.S. engagement with friends and foes alike, therefore, must reconcile this potential mismatch between resources and requirements, and between means and ends.

#### That causes war

Hayes 18 [Peter Hayes, Nautilus Institute, Berkeley, California, USA; Center for International Security Studies, Sydney University. Trump and the Interregnum of American Nuclear Hegemony. November 8, 2018. <https://www.tandfonline.com/doi/full/10.1080/25751654.2018.1532525>]

During a **post-hegemonic era**, **long-standing** nuclear **alliances** are likely to be **replaced** by **ad hoc nuclear coalitions**, aligning and realigning around different congeries of threat and even actual **nuclear wars**, with **much higher levels** of **uncertainty** and unpredictability **than** was the case in the **nuclear hegemonic system**.

There are a number of ways that this dynamic could play out during the interregnum, and these dynamics are likely to be inconsistent and contradictory. In some instances, the sheer **momentum** of past policy combined with bureaucratic inertia and the potency of political, military service and corporate interests, may ensure that **residual aspects** of the formerly **hegemonic postures** are adhered to even as formal nuclear alliances rupture. Even as they **reach for** the **old anchors**, these states may be forced to adjust and retrench strategically, or start to **take** their own **nuclear risks** by making **increasingly explicit nuclear threats** and deployments against nuclear-armed adversaries – as **Japan** has begun to do with reference to its “technological deterrent” since about 2012.9 This period could last for many years **until and when** **nuclear war breaks out** and leads to a post-nuclear war disorder; or a new, post-hegemonic strategic framework is established to manage and/or abolish nuclear threat.

**Under** full-blown **American nuclear hegemony**, **fewer states** had **nuclear weapons**, the **major nuclear** weapons **states** entered into **legally binding restraints** on force levels and they learned from nuclear near-misses to **promulgate rules** of the road and tacit understandings. The lines drawn during full-blown collisions involving nuclear weapons were stark and concentrated the minds of leaders greatly. In a nuclear duel, it was clear that only one of two sides could fire first; the only question was which one. Now, with nine nuclear weapons states, and conflicts conceivably involving three, four or more of them, no matter how much leaders concentrate, it will not be evident who is aiming at who, who may fire first, and during a volley, who fired first and even who hit whom.

In a highly proliferated world, nuclear-armed states may feel driven to obtain larger nuclear forces able to deter multiple adversaries at the same time, sufficient to conduct not only a few nuclear attacks but configured to fight **more than one** protracted **nuclear war** **at a time**, especially in nuclear states torn apart by civil war and post-nuclear attack reconstruction. The first time nuclear weapons are used since 1945 will be shocking, the second time, less so, the third time, the **new normal**.

## 1NC – Debris

#### Their plan has private entities as the actor – there’s no term of art definition of Large Satellite Constellations – proves circumvention because private entities will classify whatever they want as large or not

#### squo debris thumps –

Orwig 16 [(Jessica, MS in science and tech journalism from Texas A&M, BS in astronomy and physics from Ohio State) “Russia says a growing problem in space could be enough to spark a war,” Insider,’ January 26, 2016, <https://www.businessinsider.com/russia-says-space-junk-could-spark-war-2016-1>] TDI

NASA has already [warned that](https://www.businessinsider.com/space-junk-at-critical-density-2015-9) the large amount of space junk around our planet is growing beyond our control, but now a team of Russian scientists has cited another potentially unforeseen consequence of that debris: War.

Scientists estimate that anywhere from 500,000 to 600,000 pieces of human-made space debris between 0.4 and 4 inches in size are currently orbiting the Earth and traveling at speeds over [17,000 miles per hour](https://www.nasa.gov/mission_pages/station/news/orbital_debris.html).

If one of those pieces smashed into a military satellite it "may provoke political or even armed conflict between space-faring nations," Vitaly Adushkin, a researcher for the Institute of Geosphere Dynamics at the Russian Academy of Sciences, reported in a paper set to be published in the peer-reviewed journal [Acta Astronautica](https://www.sciencedirect.com/science/article/pii/S0094576515303416), which is sponsored by the International Academy of Astronautics.

#### It takes centuries and adaptation solves

Ted Muelhaupt 19, Associate Principal Director of the Systems Analysis and Simulation Subdivision (SASS) and Manager of the Center for Orbital and Reentry Debris Studies at The Aerospace Corporation, M.S., B.S. Aerospace and Aeronautical Engineering & Mechanics, University of Minnesota - Twin Cities, Senior Member of the American Institute of Aeronautics and Astronautics, “How Quickly Would It Take For the Kessler Syndrome To Destroy All The Satellites In LEO? And Could You See This Happening From Earth?”, Quora, 2/28/2019, https://www.quora.com/How-quickly-would-it-take-for-the-Kessler-Syndrome-to-destroy-all-the-satellites-in-LEO-And-could-you-see-this-happening-from-Earth

The dynamics of the Kessler Syndrome are real, and most people studying it agree on the concept: if there is sufficient density of objects and mass, a chain reaction of debris breaking up objects and creating more debris can occur. But the timescale of this process takes decades and centuries. There are many assumptions that go into these models. Though there is still argument about this, many people in the field think that the process is already underway in low earth orbit. But others, including myself, think we can stop it if we take action. This is a slow motion disaster that we can prevent.

But in spite of hype to the contrary, we will never “lose access to space”. Certain missions may become impractical or too expensive, and we may decide that some orbits are too risky for humans. Even that depends on the tolerance for the risk. But robots don’t have mothers, and if we feel it is worthwhile we will take the risk and fly the satellites where we need to.

To the specifics of the question, it will take many decades. It will not destroy all satellites in LEO. You won’t be able to see it from the ground unless you were extraordinarily lucky, and you happened to see a flash from a collision in the instant you were looking, with just the right lighting.

#### Squo tracking, shielding, and removal plans solve

Dr. Brian Koberlein 16, Professor of Physics at the Rochester Institute of Technology and PhD in Astrophysics from the University of Connecticut, “Cascade Effect”, 5-4, https://archive.briankoberlein.com/2016/05/04/cascade-effect/index.html

In the movie Gravity the driving force of the plot is a catastrophic cascade of space debris. An exploding satellite sends high speed debris into the path of other satellites, and the resulting collisions create more space debris until everything from a space shuttle to the International Space Station faces an eminent threat of destruction. Not unexpectedly, the movie portrayal of such a situation is not particularly accurate, but the risk of a debris cascade is very real.

It’s known as the Kessler syndrome, after Donald Kessler, who first imagined the scenario in the 1970s. The problem comes down to the fact that small objects in Earth orbit can stay in orbit for a very long time. If an astronaut drops a bolt, it can stay in orbit for decades or centuries. Because the relative speed of two objects in orbit can be quite large, it doesn’t take a big object to pose a real threat to your spacecraft. On the highway a small pebble can chip your car windshield. In space it can be done by a chip of paint traveling at thousands of kilometers per hour. In the history of the space shuttle missions, there were more than 1,600 debris strikes. Because of such strikes, more than 90 space shuttle windows had to be replaced over the lifetime of shuttle missions.

While that might sound alarming, it’s actually quite manageable. Upgrades and maintenance were quite common on the shuttle missions, and we tend to err on the side of caution when it comes to replacing parts. Modern spacecraft also have ways to mitigate the risk of small impacts, such as Whipple shields made of thin layers of material spaced apart so that objects disintegrate when hitting the shield rather than the spacecraft itself. We also have a tracking system that currently tracks more than 300,000 objects bigger than 1 cm, so we can make sure that most spacecraft avoid these objects.

But the risk of big collisions isn’t negligible. In 2009 the Iridium 33 and Kosmos-2251 satellites collided at high speed, destroying both spacecraft and creating more dangerous debris. It wouldn’t take many collisions like this for the debris numbers to rise dramatically, and more debris means a greater risk of collisions. In Gravity the cascade happens very quickly, triggered by a single event. The reality is not quite so grave. Instead of happening overnight, Kessler syndrome would occur gradually, raising collision risks to the point where certain orbits become logistically impractical. It could occur so gradually that we might not notice it early on, and there are some that argue it’s already underway.

The good news is that we’re aware of the threat. And, as the old saying goes, knowing is half the battle. Already we take steps to limit the amount of debris created. New spacecraft include end of life plans to remove them from orbit, either by sending them into Earths atmosphere to burn up, or sending them to a “graveyard orbit” that poses little risk to other spacecraft. There are also plans on the drawing board to clear orbits of debris, particularly in low-Earth orbit where the risk is greatest. The cascade effect is a real risk, but it’s also one we can likely manage with a bit of ingenuity.

#### Collision risk is infinitesimally small

Fange 17 Daniel Von Fange 17, Web Application Engineer, Founder and Owner of LeanCoder, Full Stack, Polyglot Web Developer, “Kessler Syndrome is Over Hyped”, 5/21/2017, http://braino.org/essays/kessler\_syndrome\_is\_over\_hyped/

The orbital area around earth can be broken down into four regions. Low LEO - Up to about 400km. Things that orbit here burn up in the earth’s atmosphere quickly - between a few months to two years. The space station operates at the high end of this range. It loses about a kilometer of altitude a month and if not pushed higher every few months, would soon burn up. For all practical purposes, Low LEO doesn’t matter for Kessler Syndrome. If Low LEO was ever full of space junk, we’d just wait a year and a half, and the problem would be over. High LEO - 400km to 2000km. This where most heavy satellites and most space junk orbits. The air is thin enough here that satellites only go down slowly, and they have a much farther distance to fall. It can take 50 years for stuff here to get down. This is where Kessler Syndrome could be an issue. Mid Orbit - GPS satellites and other navigation satellites travel here in lonely, long lives. The volume of space is so huge, and the number of satellites so few, that we don’t need to worry about Kessler here. GEO - If you put a satellite far enough out from earth, the speed that the satellite travels around the earth will match the speed of the surface of the earth rotating under it. From the ground, the satellite will appear to hang motionless. Usually the geostationary orbit is used by big weather satellites and big TV broadcasting satellites. (This apparent motionlessness is why satellite TV dishes can be mounted pointing in a fixed direction. You can find approximate south just by looking around at the dishes in your northern hemisphere neighborhood.) For Kessler purposes, GEO orbit is roughly a ring 384,400 km around. However, all the satellites here are moving the same direction at the same speed - debris doesn’t get free velocity from the speed of the satellites. Also, it’s quite expensive to get a satellite here, and so there aren’t many, only about one satellite per 1000km of the ring. Kessler is not a problem here. How bad could Kessler Syndrome in High LEO be? Let’s imagine a worst case scenario. An evil alien intelligence chops up everything in High LEO, turning it into 1cm cubes of death orbiting at 1000km, spread as evenly across the surface of this sphere as orbital mechanics would allow. Is humanity cut off from space? I’m guessing the world has launched about 10,000 tons of satellites total. For guessing purposes, I’ll assume 2,500 tons of satellites and junk currently in High LEO. If satellites are made of aluminum, with a density of 2.70 g/cm3, then that’s 839,985,870 1cm cubes. A sphere for an orbit of 1,000km has a surface area of 682,752,000 square KM. So there would be one cube of junk per .81 square KM. If a rocket traveled through that, its odds of hitting that cube are tiny - less than 1 in 10,000.

## 1NC – Hacking

#### Propellants are used for a wide variety of things apart from constellations

OPC ND— (Orbital Propulsion Centre, “Space Propulsion Systems for Satellites and Spacecraft“, Available Online at https://www.space-propulsion.com/spacecraft-propulsion/propulsion-systems/index.html, accessed 1-27-2022, HKR-AR)

For over half a century, we have been producing propulsion systems for a diverse range of international satellites and spacecraft. We specialise in monopropellant, bipropellant and electric ion propulsion and supply from component parts and subsystem modules, through to complete propulsion systems and beyond - with a complete range of propulsion support services from delivery, integration & test, and propellant loading, through to launch campaign support, post launch and in-orbit operations.

Applications

Typical applications of our propulsion system include:

Orbital satellites and spacecraft.

Interplanetary spacecraft and probes.

Control of re-entry vehicles.

Automated resupply missions to the International Space Station.

Ascent roll control and stabilisation of light to heavy launch vehicles .

#### Hacking of SATs by the government nonuniques this advantage– we’ve inserted in blue

Akoto 20 “Hackers could shut down satellites -- or turn them into weapons” February 13, 2020 William Akoto [a postdoctoral research fellow at the University of Denver.] <https://www.upi.com/Top_News/Voices/2020/02/13/Hackers-could-shut-down-satellites-or-turn-them-into-weapons/4091581597502/> SM

This scenario played out in 1998 when hackers took control of the U.S.-German ROSAT X-Ray satellite. They did it by hacking into computers at the Goddard Space Flight Center in Maryland. The hackers then instructed the satellite to aim its solar panels directly at the sun. This effectively fried its batteries and rendered the satellite useless. The defunct satellite eventually crashed back to Earth in 2011. Hackers could also hold satellites for ransom, as happened in 1999 when hackers took control of the U.K.'s SkyNet satellites.

Over the years, the threat of cyberattacks on satellites has gotten more dire. In 2008, hackers, possibly from China, reportedly took full control of two NASA satellites, one for about two minutes and the other for about nine minutes. In 2018, another group of Chinese state-backed hackers reportedly launched a sophisticated hacking campaign aimed at satellite operators and defense contractors. Iranian hacking groups have also attempted similar attacks.

#### 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.

#### No Terrorist groups have ever shown motive in space terrorism, they stick to easy, less sophisticated, conventional, and traceable methods of conflict – 1AC cross-ex proves they haven’t shown motive

#### Terrorists would never – they care too much about staying alive

McIntosh, PhD, and Storey, PhD, 18 – Christopher McIntosh [PhD Political Science from University of Chicago (Go Maroons!), Assistant Professor of Political Studies @ Bard] and Ian Storey [PhD Political Science from University of Chicago (Go Maroons!), Associate Fellow @ the Hannah Arendt Center for Politics and Humanities, Bard College], “Between Acquisition and Use: Assessing the Likelihood of Nuclear Terrorism,” International Studies Quarterly, Vol 62, 2018, <https://academic.oup.com/isq/article-abstract/62/2/289/4976557> C.VC

Our approach offers a point of departure for strategically assessing the options, likely responses, and potential outcomes that could arise from the different paths available to a nuclear-armed non-state group. Too often analysts treat the decision by such groups to use nuclear weapons as if it occurs in a vacuum. In practice, terrorist groups face many short-term and long-term considerations. They are influenced by factors both external and internal to their organization. These include the potential for backlash among supporters, internal factionalization over nuclear strategy and doctrine, and an overwhelming response by the target state and the international community.

Moreover, we suggest a way to bring the recursivity of strategic choice into the account of terrorist organizational decision-making. These organizations must consider the long-term effects of a nuclear attack. An attack occurs in the context of an ongoing campaign by a well-established organization. Opportunity costs exist because escalating to nuclear attack forecloses future options. As well, conducting an attack may not only preclude other strategies, but the continued existence of the group itself. This changes the game significantly. In most cases, a nuclear attack must present not just an effective option for the moment, but the only strategic option worth pursuing going forward.

Once we take these considerations into account, the detonation of a nuclear weapon generally appears the least strategically advantageous option for non-state groups. Indeed, the factors presented here are analytically independent, adaptable, and scalable to particular threat contexts. We can therefore use our framework to study the opportunities and constraints faced by specific future groups. It should therefore assist in the process of planning responses to potential nuclear acquisition by terrorist groups.

Successive governments have now identified nuclear terrorism as a critical concern in the formulation of security policy. This line of thinking systematically underspecifies, or simply misunderstands, key considerations that terrorist organizations take into account. These include the group’s organizational survival, opportunity costs, and the conflation of victory with the end of hostilities. Each factor presents strong disincentives to immediate nuclear attack. A nuclear-armed terrorist group is exceedingly dangerous, but for different reasons than normally assumed. The options available to the group that fall short of detonation or attack remain considerable, albeit less spectacular and immediate.

## 1NC – Ozone

Only about the sheer number of Starlink satellite constellations – planks 1 and 3 of counterplan both solve

#### **Also thumped by rocket launches, ASATS, non-mega constellations, autonomous space movers, etc**

#### No impact

**Ridley 14** -- Matthew White Ridley, 5th Viscount Ridley DL FRSL FMedSci, known commonly as Matt Ridley, is a British journalist, businessman and author of popular science books. Since 2013 Ridley has been a Conservative hereditary peer in the House of Lords. “THE OZONE HOLE WAS EXAGGERATED AS A PROBLEM” http://www.rationaloptimist.com/blog/the-ozone-hole-was-exaggerated-as-a-problem.aspx

Serial hyperbole does the environmental movement no favours My recent [Times column](http://www.thetimes.co.uk/tto/opinion/columnists/article4206440.ece) argued that the alleged healing of the ozone layer is exaggerated, but so was the impact of the ozone hole over Antarctica: The ozone layer is healing. Or so said the news last week. Thanks to a treaty signed in Montreal in 1989 to get rid of refrigerant chemicals called chlorofluorocarbons (CFCs), the planet’s stratospheric sunscreen has at last begun thickening again. Planetary disaster has been averted by politics. For reasons I will explain, this news deserves to be taken with a large pinch of salt. You do not have to dig far to find evidence that the ozone hole was never nearly as dangerous as some people said, that it is not necessarily healing yet and that it might not have been caused mainly by CFCs anyway. The timing of the announcement was plainly political: it came on the 25th anniversary of the treaty, and just before a big United Nations climate conference in New York, the aim of which is to push for a climate treaty modelled on the ozone one. Here’s what was actually announced last week, in the words of a Nasa scientist, Paul Newman: “From 2000 to 2013, ozone levels climbed 4 per cent in the key mid-northern latitudes.” That’s a pretty small change and it is in the wrong place. The ozone thinning that worried everybody in the 1980s was over Antarctica. Over northern latitudes, ozone concentration has been falling by about 4 per cent each March before recovering. Over Antarctica, since 1980, the ozone concentration has fallen by [40 or 50 per cent each September](http://bigstory.ap.org/article/scientists-say-ozone-layer-recovering) before the sun rebuilds it. So what’s happening to the Antarctic ozone hole? Thanks to a diligent blogger named Anthony Watts, I came across a press release also from Nasa about nine months ago, which said: “ Two new studies show that signs of recovery are not yet present, and that temperature and winds are still driving any annual changes in ozone hole size.” As recently as 2006, Nasa announced, quoting Paul Newman again, that the Antarctic ozone hole that year was “the largest ever recorded”. The following year a paper in Nature magazine from Markus Rex, a German scientist, presented new evidence that suggested CFCs may be responsible for less than 40 per cent of ozone destruction anyway. Besides, nobody knows for sure how big the ozone hole was each spring before CFCs were invented. All we know is that it varies from year to year. How much damage did the ozone hole ever threaten to do anyway? It is fascinating to go back and read what the usual hyperventilating eco-exaggerators said about ozone thinning in the 1980s. As a result of the extra ultraviolet light coming through the Antarctic ozone hole, southernmost parts of Patagonia and New Zealand see about 12 per cent more UV light than expected. This means that the weak September sunshine, though it feels much the same, has the power to cause sunburn more like that of latitudes a few hundred miles north. Hardly Armageddon. The New York Times reported “an increase in Twilight Zone-type reports of sheep and rabbits with cataracts” in southern Chile. Not to be outdone, Al Gore wrote that “hunters now report finding blind rabbits; fisherman catch blind salmon”. Zoologists briefly blamed the near extinction of many amphibian species on thin ozone. Melanoma in people was also said to be on the rise as a result. This was nonsense. Frogs were dying out because of a fungal disease spread from Africa — nothing to do with ozone. Rabbits and fish blinded by a little extra sunlight proved to be as mythical as unicorns. An eye disease in Chilean sheep was happening outside the ozone-depleted zone and was caused by an infection called pinkeye — nothing to do with UV light. And melanoma incidence in people actually levelled out during the period when the ozone got thinner. Then remember that the ozone hole appears when the sky is dark all day, and over an uninhabited continent. Even if it persists into the Antarctic spring and spills north briefly, the hole allows 50 times less ultraviolet light through than would hit your skin at the equator at sea level (let alone at a high altitude) in the tropics. So it would be bonkers to worry about UV as you sailed round Cape Horn in spring, say, but not when you stopped at the Galapagos: the skin cancer risk is 50 times higher in the latter place. This kind of eco-exaggeration has been going on for 50 years. In the 1960s Rachel Carson said there was an epidemic of childhood cancer caused by DDT; it was not true — DDT had environmental effects but did not cause human cancers. In the 1970s the Sahara desert was said be advancing a mile a year; it was not true — the region south of the Sahara has grown markedly greener and more thickly vegetated in recent decades. In the 1980s acid rain was said to be devastating European forests; not true — any local declines in woodland were caused by pests or local pollution, not by the sulphates and nitrates in rain, which may have contributed to an actual increase in the overall growth rate of European forests during the decade. In the 1990s sperm counts were said to be plummeting thanks to pollution with man-made “endocrine disruptor” chemicals; not true — there was no fall in sperm counts. In the 2000s the Gulf Stream was said to be failing and hurricanes were said to be getting more numerous and worse, thanks to global warming; neither was true, except in a Hollywood studio. The motive for last week’s announcement was to nudge world leaders towards a treaty on climate change by reminding them of how well the ozone treaty worked. But getting the world to agree to cease production of one rare class of chemical, for which substitutes existed, and which only a few companies mainly in rich countries manufactured, was a very different proposition from setting out to decarbonise the whole economy, when each of us depends on burning carbon (and hydrogen) for almost every product, service, meal, comfort and journey in our lives. The true lesson of the ozone story is that taking precautionary action on the basis of dubious evidence and exaggerated claims might be all right if the action does relatively little economic harm. However, loading the entire world economy with costly energy, and new environmental risks based on exaggerated claims about what might in future happen to the climate makes less sense.

## 1NC – Grid

#### Also about SpaceX

#### Urban illumination is a massive alt cause that overwhelms satellites in low earth orbit

ISC 12/21/21 (International Science Council Interviewing Piero Benvenuti of the International Astronomical Union, "The artifical constellations impacting on astronomical science," <https://council.science/current/blog/the-artificial-constellations-impacting-on-astronomical-science/> DD)

The urban illumination or ALAN (Artificial Light At Night); The optical/infrared trails of the satellites in low-Earth orbits (LEO); The radio transmission by ground and space emitters that affects radio astronomy. The interference by ALAN, that affects both amateur and professional astronomers, has become an acute problem with the advent of the LED

(Light Emission Diodes), particularly by those with a high level of blue light. The International Astronomical Union has established a recommended maximum tolerable threshold of light pollution for astronomical sites of 10% above natural background levels. Light pollution is growing globally at an estimated rate of 2 to 6 % per year and is reducing darkness everywhere, including at observatory sites where world-class sites risk hitting the 10% threshold in the next decade. In addition to the impact on astronomy, artificial light at night may have significant biological effects, to flora and fauna, vertebrates and invertebrates, which requires further study by appropriate experts.

#### Flares, wind, CMEs, and cosmic rays thump – they only solve flares

Dr. Mariel Borowitz 19, Ph.D. from the University of Maryland School of Public Policy, Assistant Professor of International Affairs at Georgia Tech, February 2019, “Strategic Implications of the Proliferation of Space Situational Awareness Technology and Information: Lessons Learned from the Remote Sensing Sector,” Space Policy, Vol. 47, p. 18-27

Purposeful attacks are not the only concern—space weather events and accidental collisions can also damage satellites. The Sun periodically erupts with solar flares and coronal mass ejections, which can send energetic particles or plasma hurling toward the Earth. Solar wind and galactic cosmic rays constantly bombard our planet and the space around it. These space weather phenomena can interfere with signals from satellites, increase the drag on satellites as they orbit, or even disrupt sensitive satellite electronics. Furthermore, the active satellites that provide the many critical applications described previously operate in a field of orbital debris—defunct satellites, pieces of spacecraft that have disintegrated, discarded rocket components, and other objects—all traveling at more than 28,000 km per hour (17,500 miles per hour). Overall, there are more than 20,000 objects larger than 10 cm orbiting the earth, each of which could result in the complete destruction of an operational spacecraft in the case of a collision. Objects smaller than 10 cm, of which an estimated 500,000 orbit the Earth, would also be capable of causing significant damage [2]. As the Rumsfeld Commission recognized in 2001, the potential for satellite damage or destruction to be caused by natural phenomena can be used to mask purposeful attacks [1].