## Debris

#### Privatization of space is unsustainable and increases debris – triggers the Kessler Syndrome

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Back in 1978, the astrophysicist Donald Kessler made an alarming prediction: Space junk could wreck our ability to keep satellites aloft. In a fascinating paper, Kessler noted that “low earth orbit” — a region between 99 miles and 1,200 miles up — was getting pretty crowded. In 1978 there were already 3,866 objects being tracked in space. That included satellites used by scientists (say, to monitor weather) or spy agencies. It also included a lot of debris: Every time a rocket launches a satellite into orbit, it tends to leave stray bits of material. The thing is, when objects are zooming through space about 2 km/s, even something as tiny as a chip of paint can smash through glass or steel. Pieces of debris become bullets. What Kessler predicted is that sooner or later, objects in low-earth orbit would start colliding, and produce chain effects, like billiard balls colliding on a crowded pool table. If a piece of debris hit a satellite, it would produce more debris, which would to increase the risk of other collisions … and so on, and so on. At some point, you could reach a tipping point. There’d be so many chunks of debris that collisions would be inevitable, leaving low-earth orbit a junkyard where no satellites could survive. Remember the scene in Wall-E where they blast off Earth, and the planet is utterly ringed with crap? That’s what Kessler worried about. Except in our situation the pieces of junk could be quite small — billions of objects the size of grains of sand, which is actually a lot harder to deal with, because you can’t see it coming. In essence, Kessler predicted we could create an artificial asteroid belt of junk: The result would be an exponential increase in the number of objects with time, creating a belt of debris around the earth. This process of mutual collisions is thought to have been responsible for creating most of the astroids from larger planetlike bodies. Space folks began calling this the “Kessler Syndrome”. It was hard to predict when this might start happening. Kessler worried that conditions could be ripe by as early as 2000. Thankfully, that estimate turned out to be premature. But wow, it looks like it might happen soon. What’s happened recently that makes the “Kessler Syndrome” more likely? A couple of things: Way more satellites are going up The pace at which satellites are going up in the sky is simply exploding. Back when Kessler wrote his paper in 1978, we humans were launching about 53 new satellites a year. Going to space was hard. But now launches are an order of magnitude more common, and they’re increasing in pace rapidly. SpaceX in particular is launching oodles of satellites as it builds its orbital Internet-access service Starlink. In the last two years, it has put 1,740 satellites in low-earth orbit, with plans to eventually shoot 30,000 up there. This is part of a larger trend, which is … The privatization of outer space The private sector is rapidly becoming the dominant actor in space. There’s a huge demand for satellite data — everyone wants better info about weather, crops, traffic patterns, tree coverage, emissions, you name it, on top of the explosive use of satellites for communication and Internet. SpaceX’s remarkable innovations in rocketry (the leading folks, though others are following in their footsteps) have made it cheaper than ever to get a satellite into orbit. It is unlocking a huge pent-up demand for near-earth-orbit tech. More launches mean not only more intentional objects in orbit but unintentional ones — bits of rocket parts and detritus from launches.

#### Privatization exponentially increases the curve but ending dangerous missions prevents it.

Bernat 20 [Pawel, 2020, Military University of Aviation, “ORBITAL SATELLITE CONSTELLATIONS AND THE GROWING THREAT OF KESSLER SYNDROME IN THE LOWER EARTH ORBIT,” SAFETY ENGINEERING OF ANTHROPOGENIC OBJECTS, Volume 4, PDF] Justin

5. Orbital satellite constellations and the growing threat of the Kessler syndrome Space 2.0 – the new era of space exploration that we witness now in the 21st century means, in words of Buzz Aldrin, “moving human enterprise into space” (Pyle, 2019, p. xiv). The process of commercialization of outer space has already begun and is not limited to private companies providing technologies and services for national or international space agencies, as it was in the past. On the contrary, private companies from the space sector have now matured to carry out their own independent projects. As for 2020, SpaceX is a company that serves as the best example – it launches satellites to the orbit, both for state and private contractors, it successfully realized two crew missions to the International Space Station, and is in the process of constructing Starlink satellite constellation that will provide high-speed internet access across the planet. Each satellite weighs around 260 kg, is equipped with an ion propulsion system, autonomous collision avoidance system, and orbits Earth at approximately 540-560 km altitude (Starlink, 2020). At the beginning of November 2020, more than 860 Starlink satellites were orbiting the Earth (Jewett, 2020). Immediate plans include launching 12,000 satellites, but they assume a potential later extension to 42,000 (Henry, 2019a). Of course, SpaceX has employed, at least declaratively, all necessary measures to keep the space clean – the satellites are equipped with the deorbiting system, and in the event of inoperability of the propulsion system (Starlink, 2020). The orbital collisions are, however, inevitable. As it was shown before, the possibility of collisions grows with the number of orbital objects. Bastida Virgili with the team compared (2016, p. 154-155) orbital debris environment development without and with a large hypothetical constellation consisting of merely 1080 satellites, distributed across 20 orbital planes at 1,100 km altitude (Fig. 5).

Chart, line chart

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It has to be noted that although SpaceX’s Starlink is the only constellation that is being built in orbit, it is not the only one planned. There are at least a few initiatives aiming at the same goal – to construct internet infrastructure at the Earth’s orbit. The planned Kuiper Systems LLC, which is a subsidiary of Amazon and intends to place 3,236 broadband satellites in the LEO, is one of Starlink’s biggest competitors (Henry, 2019b). Now, there is even a rivalry between the two companies because Kuiper’s lowest orbital shell is planned to be 590 km, with a tolerance of 9 km either above or below (Cao, 2020), which is the altitude of Starlink satellites. Moreover, the race for space in orbit is now at the beginning. The outer space is vast. It increasingly becomes more cluttered with both operational satellites and space debris. The threat of collisions increases and no institution or body has enough power to license, coordinate and regulate what is sent to the orbit. The UNOOSA has not such power. National states decide what the companies from the space industry can launch to space. In the United States, which is most advanced in the area of private constellations, it is the Federal Aviation Administration (FAA) that issues the appropriate approvals. The race to put broadband internet satellites bears similarities to the gold rush – there are no rules, at the global level, apart from first-come, first-served.

#### Debris causes nuclear war---Noko, Iran, and China.

Beauchamp 14 – Zack, 4/21/14, Zack Beauchamp is a senior correspondent at Vox, where he covers global politics and ideology, and a host of Worldly, Vox's podcast on foreign policy and international relations. His work focuses on the rise of the populist right across the West, the role of identity in American politics, and how fringe ideologies shape the mainstream. Before coming to Vox, he edited TP Ideas, a section of Think Progress devoted to the ideas shaping our political world. He has an MSc from the London School of Economics in International Relations and grew up in Washington, DC, where he currently lives with his wife, daughter, and two (rescue) dogs [“How space trash could start a nuclear war,” Vox, <https://www.vox.com/2014/4/21/5625246/space-war-china-north-korea-iran>] Justin \*Brackets added for ableist language

If debris from a Chinese test destroys a US military satellite, the US could mistake it as a preemptive strike against its space capabilities — some of which are designed to detect nuclear missile launches. If the US thinks China is trying to take out its ability to detect a nuclear launch, things could get very bad, very quickly. Accidents aren't the only concern. Zenko also worries about intentional space attacks, either during peacetime or a crisis. Here, Iran and North Korea are probably bigger threats, though their ASAT capabilities are far from proven. North Korea has a pattern of ~~crazy~~ [irrational] military moves designed to extort concessions from South Korea and the West; it could extend that behavior to space. Iran, according to Zenko, "already views space as a legitimate arena in which to contest US military power." He worries that Iran might fire missiles into space "during a major crisis, especially if it believes war is imminent — an assessment that could have self-fulfilling consequences."

#### Any nuclear war causes extinction – ice age and famine.

Steven Starr 15 [Director of the University of Missouri’s Clinical Laboratory Science Program, as well as a senior scientist at the [Physicians for Social Responsibility](http://www.psr.org/). He has worked with the Swiss, Chilean, and Swedish governments in support of their efforts at the United Nations to eliminate thousands of high-alert, launch-ready U.S. and Russian nuclear weapons. “Nuclear War: An Unrecognized Mass Extinction Event Waiting To Happen.” Ratical. March 2015. <https://ratical.org/radiation/NuclearExtinction/StevenStarr022815.html>] TG

A war fought with 21st century strategic nuclear weapons would be more than just a great catastrophe in human history. If we allow it to happen, such a war would be a mass extinction event that [ends human history](https://ratical.org/radiation/NuclearExtinction/StarrNuclearWinterOct09.pdf). There is a profound difference between extinction and “an unprecedented disaster,” or even “the end of civilization,” because even after such an immense catastrophe, human life would go on. But extinction, by definition, is an event of utter finality, and a nuclear war that could cause human extinction should really be considered as the ultimate criminal act. It certainly would be the crime to end all crimes. The world’s leading climatologists now tell us that nuclear war threatens our continued existence as a species. Their studies predict that a large nuclear war, especially one fought with strategic nuclear weapons, would create [a post-war environment in which for many years it would be too cold and dark to even grow food](http://climate.envsci.rutgers.edu/pdf/RobockToonSAD.pdf). Their findings make it clear that not only humans, but most large animals and many other forms of complex life would likely vanish forever in a nuclear darkness of our own making. The environmental consequences of nuclear war would attack the ecological support systems of life at every level. Radioactive fallout, produced not only by nuclear bombs, but also by the destruction of nuclear power plants and their spent fuel pools, would poison the biosphere. Millions of tons of smoke would act to [destroy Earth’s protective ozone layer](https://www2.ucar.edu/atmosnews/just-published/3995/nuclear-war-and-ultraviolet-radiation) and block most sunlight from reaching Earth’s surface, creating Ice Age weather conditions that would last for decades. Yet the political and military leaders who control nuclear weapons strictly avoid any direct public discussion of the consequences of nuclear war. They do so by arguing that nuclear weapons are not intended to be used, but only to deter. Remarkably, the leaders of the Nuclear Weapon States have chosen to ignore the authoritative, long-standing scientific research done by the climatologists, research that predicts virtually any nuclear war, fought with even a fraction of the operational and deployed nuclear arsenals, will leave the Earth essentially uninhabitable.

## Launches

#### Commercial Space Industry requires an enormous increase in launches – that causes pollutants and warming.

Gammon 21 Katharine Gammon 7-19-2021 "How the billionaire space race could be one giant leap for pollution" <https://www.theguardian.com/science/2021/jul/19/billionaires-space-tourism-environment-emissions> (I’m an award-winning independent science journalist based in Santa Monica, California. My interests range from culture and nature in public lands to the lives of scientists to the complexity of baby brains. Before I became a professional journalist, I served in the Peace Corps in Bulgaria, and attended MIT and Princeton University.)//Elmer

Last week Virgin Galactic took Richard Branson past the edge of space, roughly 86 km up – part of a new space race with the Amazon billionaire Jeff Bezos, who aims to make a similar journey on Tuesday. Both very wealthy businessmen hope to vastly expand the number of people in space. “We’re here to make space more accessible to all,” said Branson, shortly after his flight. “Welcome to the dawn of a new space age.” Already, people are buying tickets to space. Companies including SpaceX, Virgin Galactic and Space Adventures want to make space tourism more common. The Japanese billionaire Yusaku Maezawa spent an undisclosed sum of money with SpaceX in 2018 for a possible future private trip around the moon and back. And this June, an anonymous space lover paid $28m to fly on Blue Origin’s New Shepard with Bezos – though later backed out due to a “scheduling conflict”. But this launch of a new private space industry that is cultivating tourism and popular use could come with vast environmental costs, says Eloise Marais, an associate professor of physical geography at University College London. Marais studies the impact of fuels and industries on the atmosphere. When rockets launch into space, they require a huge amount of propellants to make it out of the Earth’s atmosphere. For SpaceX’s Falcon 9 rocket, it is kerosene, and for Nasa it is liquid hydrogen in their new Space Launch System. Those fuels emit a variety of substances into the atmosphere, including carbon dioxide, water, chlorine and other chemicals. The carbon emissions from rockets are small compared with the aircraft industry, she says. But they are increasing at nearly 5.6% a year, and Marais has been running a simulation for a decade, to figure out at what point will they compete with traditional sources we are familiar with. “For one long-haul plane flight it’s one to three tons of carbon dioxide [per passenger],” says Marais. For one rocket launch 200-300 tonnes of carbon dioxide are split between 4 or so passengers, according to Marais. “So it doesn’t need to grow that much more to compete with other sources.” Right now, the number of rocket flights is very small: in the whole of 2020, for instance, there were 114 attempted orbital launches in the world, according to Nasa. That compares with the airline industry’s more than 100,000 flights each day on average. But emissions from rockets are emitted right into the upper atmosphere, which means they stay there for a long time: two to three years. Even water injected into the upper atmosphere – where it can form clouds – can have warming impacts, says Marais. “Even something as seemingly innocuous as water can have an impact.” Closer to the ground, all fuels emit huge amounts of heat, which can add ozone to the troposphere, where it acts like a greenhouse gas and retains heat. In addition to carbon dioxide, fuels like kerosene and methane also produce soot. And in the upper atmosphere, the ozone layer can be destroyed by the combination of elements from burning fuels. “While there are a number of environmental impacts resulting from the launch of space vehicles, the depletion of stratospheric ozone is the most studied and most immediately concerning,” wrote Jessica Dallas, a senior policy adviser at the New Zealand Space Agency, in an analysis of research on space launch emissions published last year. Another report from 2019 penned by the Center for Space Policy and Strategy likened the space emissions problem to that of space debris, which the authors say creates an existential risk to the industry. “Today, launch vehicle emissions present a distinctive echo of the space debris problem. Rocket engine exhaust emitted into the stratosphere during ascent to orbit adversely impacts the global atmosphere,” they wrote. “We just don’t know how large the space tourism industry could become,” says Marais. A new market report estimates that the global suborbital transportation and space tourism market is estimated to reach $2.58bn in 2031, growing 17.15% each year of the next decade. “The major driving factor for the market’s robustness will be focused efforts to enable space transportation, emerging startups in suborbital transportation, and increasing developments in low-cost launching sites,” the report says. In the past, most space transportation has been focused on cargo supply missions to the International Space Station and satellite launch services, but currently, this focus has shifted to in-space transportation, planetary explorations, crewed missions, suborbital transportation and space tourism. Several companies, including SpaceX, Blue Origin and Virgin Galactic, have been focusing on developing platforms such as rocket-powered suborbital vehicles that will enable the industry to carry out suborbital transportation and space tourism. People have pointed out that the money these billionaires have poured into space technology could be invested in making life better on our planet, where wildfires, heatwaves and other climate disasters are becoming more frequent as the globe warms up in the climate crisis. “Is anyone else alarmed that billionaires are having their own private space race while record-breaking heatwaves are sparking a ‘fire-breathing dragon of clouds’ and cooking sea creatures to death in their shells?” the former US Labor Secretary Robert Reich tweeted last week. Marais says that there is always an element of excitement to new developments in space – but it’s still possible to be responsible while doing something exciting. She urges caution as the space tourism industry grows, and says there are currently no international rules around the kinds of fuels used and their impact on the environment. “We have no regulations currently around rocket emissions,” she says. “The time to act is now – while the billionaires are still buying their tickets.”

#### Status Quo Launches are goldilocks, but Commercialization increases it ten-fold which overwhelms alt-causes – specifically decks the Ozone Layer.

Marais 21 Eloise Marais 7-19-2021 "Space tourism: rockets emit 100 times more CO₂ per passenger than flights – imagine a whole industry" <https://theconversation.com/space-tourism-rockets-emit-100-times-more-co-per-passenger-than-flights-imagine-a-whole-industry-164601> (Associate Professor in Physical Geography, UCL)//Elmer

The commercial race to get tourists to space is heating up between Virgin Group founder Sir Richard Branson and former Amazon CEO Jeff Bezos. On Sunday 11 July, Branson ascended 80 km to reach the edge of space in his piloted Virgin Galactic VSS Unity spaceplane. Bezos’ autonomous Blue Origin rocket is due to launch on July 20, coinciding with the anniversary of the Apollo 11 Moon landing. Though Bezos loses to Branson in time, he is set to reach higher altitudes (about 120 km). The launch will demonstrate his offering to very wealthy tourists: the opportunity to truly reach outer space. Both tour packages will provide passengers with a brief ten-minute frolic in zero gravity and glimpses of Earth from space. Not to be outdone, Elon Musk’s SpaceX will provide four to five days of orbital travel with its Crew Dragon capsule later in 2021. What are the environmental consequences of a space tourism industry likely to be? Bezos boasts his Blue Origin rockets are greener than Branson’s VSS Unity. The Blue Engine 3 (BE-3) will launch Bezos, his brother and two guests into space using liquid hydrogen and liquid oxygen propellants. VSS Unity used a hybrid propellant comprised of a solid carbon-based fuel, hydroxyl-terminated polybutadiene (HTPB), and a liquid oxidant, nitrous oxide (laughing gas). The SpaceX Falcon series of reusable rockets will propel the Crew Dragon into orbit using liquid kerosene and liquid oxygen. Burning these propellants provides the energy needed to launch rockets into space while also generating greenhouse gases and air pollutants. Large quantities of water vapour are produced by burning the BE-3 propellant, while combustion of both the VSS Unity and Falcon fuels produces CO₂, soot and some water vapour. The nitrogen-based oxidant used by VSS Unity also generates nitrogen oxides, compounds that contribute to air pollution closer to Earth. Roughly two-thirds of the propellant exhaust is released into the stratosphere (12 km-50 km) and mesosphere (50 km-85 km), where it can persist for at least two to three years. The very high temperatures during launch and re-entry (when the protective heat shields of the returning crafts burn up) also convert stable nitrogen in the air into reactive nitrogen oxides. These gases and particles have many negative effects on the atmosphere. In the stratosphere, nitrogen oxides and chemicals formed from the breakdown of water vapour convert ozone into oxygen, depleting the ozone layer which guards life on Earth against harmful UV radiation. Water vapour also produces stratospheric clouds that provide a surface for this reaction to occur at a faster pace than it otherwise would. Space tourism and climate change Exhaust emissions of CO₂ and soot trap heat in the atmosphere, contributing to global warming. Cooling of the atmosphere can also occur, as clouds formed from the emitted water vapour reflect incoming sunlight back to space. A depleted ozone layer would also absorb less incoming sunlight, and so heat the stratosphere less. Figuring out the overall effect of rocket launches on the atmosphere will require detailed modelling, in order to account for these complex processes and the persistence of these pollutants in the upper atmosphere. Equally important is a clear understanding of how the space tourism industry will develop. Virgin Galactic anticipates it will offer 400 spaceflights each year to the privileged few who can afford them. Blue Origin and SpaceX have yet to announce their plans. But globally, rocket launches wouldn’t need to increase by much from the current 100 or so performed each year to induce harmful effects that are competitive with other sources, like ozone-depleting chlorofluorocarbons (CFCs), and CO₂ from aircraft. During launch, rockets can emit between four and ten times more nitrogen oxides than Drax, the largest thermal power plant in the UK, over the same period. CO₂ emissions for the four or so tourists on a space flight will be between 50 and 100 times more than the one to three tonnes per passenger on a long-haul flight. In order for international regulators to keep up with this nascent industry and control its pollution properly, scientists need a better understanding of the effect these billionaire astronauts will have on our planet’s atmosphere.

#### Warming causes Extinction

Kareiva 18, Peter, and Valerie Carranza. "Existential risk due to ecosystem collapse: Nature strikes back." Futures 102 (2018): 39-50. (Ph.D. in ecology and applied mathematics from Cornell University, director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA)//Re-cut by Elmer

In summary, six of the nine proposed planetary boundaries (phosphorous, nitrogen, biodiversity, land use, atmospheric aerosol loading, and chemical pollution) are unlikely to be associated with existential risks. They all correspond to a degraded environment, but in our assessment do not represent existential risks. However, the three remaining boundaries (**climate change**, global **freshwater** cycle, **and** ocean **acidification**) do **pose existential risks**. This is **because of** intrinsic **positive feedback loops**, substantial lag times between system change and experiencing the consequences of that change, and the fact these different boundaries interact with one another in ways that yield surprises. In addition, climate, freshwater, and ocean acidification are all **directly connected to** the provision of **food and water**, and **shortages** of food and water can **create conflict** and social unrest. Climate change has a long history of disrupting civilizations and sometimes precipitating the collapse of cultures or mass emigrations (McMichael, 2017). For example, the 12th century drought in the North American Southwest is held responsible for the collapse of the Anasazi pueblo culture. More recently, the infamous potato famine of 1846–1849 and the large migration of Irish to the U.S. can be traced to a combination of factors, one of which was climate. Specifically, 1846 was an unusually warm and moist year in Ireland, providing the climatic conditions favorable to the fungus that caused the potato blight. As is so often the case, poor government had a role as well—as the British government forbade the import of grains from outside Britain (imports that could have helped to redress the ravaged potato yields). Climate change intersects with freshwater resources because it is expected to exacerbate drought and water scarcity, as well as flooding. Climate change can even impair water quality because it is associated with heavy rains that overwhelm sewage treatment facilities, or because it results in higher concentrations of pollutants in groundwater as a result of enhanced evaporation and reduced groundwater recharge. **Ample clean water** is not a luxury—it **is essential for human survival**. Consequently, cities, regions and nations that lack clean freshwater are vulnerable to social disruption and disease. Finally, ocean acidification is linked to climate change because it is driven by CO2 emissions just as global warming is. With close to 20% of the world’s protein coming from oceans (FAO, 2016), the potential for severe impacts due to acidification is obvious. Less obvious, but perhaps more insidious, is the interaction between climate change and the loss of oyster and coral reefs due to acidification. Acidification is known to interfere with oyster reef building and coral reefs. Climate change also increases storm frequency and severity. Coral reefs and oyster reefs provide protection from storm surge because they reduce wave energy (Spalding et al., 2014). If these reefs are lost due to acidification at the same time as storms become more severe and sea level rises, coastal communities will be exposed to unprecedented storm surge—and may be ravaged by recurrent storms. A key feature of the risk associated with climate change is that mean annual temperature and mean annual rainfall are not the variables of interest. Rather it is extreme episodic events that place nations and entire regions of the world at risk. These extreme events are by definition “rare” (once every hundred years), and changes in their likelihood are challenging to detect because of their rarity, but are exactly the manifestations of climate change that we must get better at anticipating (Diffenbaugh et al., 2017). Society will have a hard time responding to shorter intervals between rare extreme events because in the lifespan of an individual human, a person might experience as few as two or three extreme events. How likely is it that you would notice a change in the interval between events that are separated by decades, especially given that the interval is not regular but varies stochastically? A concrete example of this dilemma can be found in the past and expected future changes in storm-related flooding of New York City. The highly disruptive flooding of New York City associated with Hurricane Sandy represented a flood height that occurred once every 500 years in the 18th century, and that occurs now once every 25 years, but is expected to occur once every 5 years by 2050 (Garner et al., 2017). This change in frequency of extreme floods has profound implications for the measures New York City should take to protect its infrastructure and its population, yet because of the stochastic nature of such events, this shift in flood frequency is an elevated risk that will go unnoticed by most people. 4. The combination of positive feedback loops and societal inertia is fertile ground for global environmental catastrophes **Humans** are remarkably ingenious, and **have adapted** to crises **throughout** their **history**. Our doom has been repeatedly predicted, only to be averted by innovation (Ridley, 2011). **However**, the many **stories** **of** human ingenuity **successfully** **addressing** **existential risks** such as global famine or extreme air pollution **represent** environmental c**hallenges that are** largely **linear**, have immediate consequences, **and operate without positive feedbacks**. For example, the fact that food is in short supply does not increase the rate at which humans consume food—thereby increasing the shortage. Similarly, massive air pollution episodes such as the London fog of 1952 that killed 12,000 people did not make future air pollution events more likely. In fact it was just the opposite—the London fog sent such a clear message that Britain quickly enacted pollution control measures (Stradling, 2016). Food shortages, air pollution, water pollution, etc. send immediate signals to society of harm, which then trigger a negative feedback of society seeking to reduce the harm. In contrast, today’s great environmental crisis of climate change may cause some harm but there are generally long time delays between rising CO2 concentrations and damage to humans. The consequence of these delays are an absence of urgency; thus although 70% of Americans believe global warming is happening, only 40% think it will harm them (http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/). Secondly, unlike past environmental challenges, **the Earth’s climate system is rife with positive feedback loops**. In particular, as CO2 increases and the climate warms, that **very warming can cause more CO2 release** which further increases global warming, and then more CO2, and so on. Table 2 summarizes the best documented positive feedback loops for the Earth’s climate system. These feedbacks can be neatly categorized into carbon cycle, biogeochemical, biogeophysical, cloud, ice-albedo, and water vapor feedbacks. As important as it is to understand these feedbacks individually, it is even more essential to study the interactive nature of these feedbacks. Modeling studies show that when interactions among feedback loops are included, uncertainty increases dramatically and there is a heightened potential for perturbations to be magnified (e.g., Cox, Betts, Jones, Spall, & Totterdell, 2000; Hajima, Tachiiri, Ito, & Kawamiya, 2014; Knutti & Rugenstein, 2015; Rosenfeld, Sherwood, Wood, & Donner, 2014). This produces a wide range of future scenarios. Positive feedbacks in the carbon cycle involves the enhancement of future carbon contributions to the atmosphere due to some initial increase in atmospheric CO2. This happens because as CO2 accumulates, it reduces the efficiency in which oceans and terrestrial ecosystems sequester carbon, which in return feeds back to exacerbate climate change (Friedlingstein et al., 2001). Warming can also increase the rate at which organic matter decays and carbon is released into the atmosphere, thereby causing more warming (Melillo et al., 2017). Increases in food shortages and lack of water is also of major concern when biogeophysical feedback mechanisms perpetuate drought conditions. The underlying mechanism here is that losses in vegetation increases the surface albedo, which suppresses rainfall, and thus enhances future vegetation loss and more suppression of rainfall—thereby initiating or prolonging a drought (Chamey, Stone, & Quirk, 1975). To top it off, overgrazing depletes the soil, leading to augmented vegetation loss (Anderies, Janssen, & Walker, 2002). Climate change often also increases the risk of forest fires, as a result of higher temperatures and persistent drought conditions. The expectation is that **forest fires will become more frequent** and severe with climate warming and drought (Scholze, Knorr, Arnell, & Prentice, 2006), a trend for which we have already seen evidence (Allen et al., 2010). Tragically, the increased severity and risk of Southern California wildfires recently predicted by climate scientists (Jin et al., 2015), was realized in December 2017, with the largest fire in the history of California (the “Thomas fire” that burned 282,000 acres, https://www.vox.com/2017/12/27/16822180/thomas-fire-california-largest-wildfire). This **catastrophic fire** embodies the sorts of positive feedbacks and interacting factors that **could catch humanity off-guard and produce a** true **apocalyptic event.** Record-breaking rains produced an extraordinary flush of new vegetation, that then dried out as record heat waves and dry conditions took hold, coupled with stronger than normal winds, and ignition. Of course the record-fire released CO2 into the atmosphere, thereby contributing to future warming. Out of all types of feedbacks, water vapor and the ice-albedo feedbacks are the most clearly understood mechanisms. Losses in reflective snow and ice cover drive up surface temperatures, leading to even more melting of snow and ice cover—this is known as the ice-albedo feedback (Curry, Schramm, & Ebert, 1995). As snow and ice continue to melt at a more rapid pace, millions of people may be displaced by flooding risks as a consequence of sea level rise near coastal communities (Biermann & Boas, 2010; Myers, 2002; Nicholls et al., 2011). The water vapor feedback operates when warmer atmospheric conditions strengthen the saturation vapor pressure, which creates a warming effect given water vapor’s strong greenhouse gas properties (Manabe & Wetherald, 1967). Global warming tends to increase cloud formation because warmer temperatures lead to more evaporation of water into the atmosphere, and warmer temperature also allows the atmosphere to hold more water. The key question is whether this increase in clouds associated with global warming will result in a positive feedback loop (more warming) or a negative feedback loop (less warming). For decades, scientists have sought to answer this question and understand the net role clouds play in future climate projections (Schneider et al., 2017). Clouds are complex because they both have a cooling (reflecting incoming solar radiation) and warming (absorbing incoming solar radiation) effect (Lashof, DeAngelo, Saleska, & Harte, 1997). The type of cloud, altitude, and optical properties combine to determine how these countervailing effects balance out. Although still under debate, it appears that in most circumstances the cloud feedback is likely positive (Boucher et al., 2013). For example, models and observations show that increasing greenhouse gas concentrations reduces the low-level cloud fraction in the Northeast Pacific at decadal time scales. This then has a positive feedback effect and enhances climate warming since less solar radiation is reflected by the atmosphere (Clement, Burgman, & Norris, 2009). The key lesson from the long list of potentially positive feedbacks and their interactions is that **runaway climate change,** and runaway perturbations have to be taken as a serious possibility. Table 2 is just a snapshot of the type of feedbacks that have been identified (see Supplementary material for a more thorough explanation of positive feedback loops). However, this list is not exhaustive and the possibility of undiscovered positive feedbacks **portends** even greater **existential risks**. The many environmental crises humankind has previously averted (famine, ozone depletion, London fog, water pollution, etc.) were averted because of political will based on solid scientific understanding. We cannot count on complete scientific understanding when it comes to positive feedback loops and climate change.

## Space Militarization

#### Desire to protect profitable LEO constellations leads states to militarize outer space—specifically with ASATs.

Bernat 19 “The Inevitability of Militarization of Outer Space” Pawel Bernat [Assistant Professor, Polish Air Force University] Safety & Defense 5(1) (2019) 49–54 <https://philarchive.org/archive/BERTIO-52> SM

Currently, the dominant interpretations of this article argue that the placement of conventional weapons, including systems with nuclear drives, in orbit does not violate the provisions of the Treaty (Bourbonniere & Lee, 2008). The Treaty, according to these elucidations, does not also prohibit nuclear weapons or weapons of mass destruction on trajectory passing through space, as it is the case with the Russian ballistic missile RS-28 Sarmat. However, it prohibits placing and keeping biological, bacteriological, chemical, and nuclear weapons in orbit (Boothby, 2017).

Of course, there are also other interpretations, according to which the Treaty has been infringed more than once. They are based on the quite right belief that in the case of modern weapons, one should talk about systems rather than a single ballistic missile. After all, the satellite navigation system was created as part of a ballistic missile guidance system with thermonuclear warheads (LaGrone, 2014). Therefore, we are dealing here with a very important philosophical and legal question whether the satellite being a part of such a system is a weapon and hence prohibited by the Treaty. This brings us back to the difficulty of clear and sound definition of the term “space weapon” addressed before. Does the fact that a civil communication satellite can be used (and often is) for military purposes make it a part of a weapon system? If so, what would be the consequences, especially if we took into consideration the fact that approximately 95% of satellites could be used that way? These questions, although theoretical in nature, bear significant consequences for the binding power of the Treaty, and therefore the whole outer space legal framework.

So far, however, the Treaty has been fulfilling its task quite well, and its provisions have been relatively seldom broken or violated. On the other hand, we are currently witnessing an undoubted renaissance of the space sector, which also applies to offensive and defensive military technologies and programs. The structure of the sector has changed as well – the twentieth-century traditional bipolar competition between the United States and the Soviet Union is long gone. New entities have appeared in the game, both, private companies, such as SpaceX, Blue Origin, Virgin Galactic and Virgin Orbit, Bigelow Aerospace, Rocket Lab, and national agencies – Indian ISRO (Indian Space Research Organization) or Chinese CNSA (China National Space Administration), which joined the key global actors like American NASA, Russian Roscosmos, European ESA, or Japanese JAXA. The record of orbital launches – 139, was set in 1967 (Kyle, 2019a). It may seem surprising that humanity has not been able to break this record for over 50 years. However, since the middle of the first decade of the 21st century, we have been observing a steady increase in the number of orbital launches (52 in 2005, 70 in 2010, 114 in 2018), and it seems that this record will be broken in 2019 because 173 starts are planned (Kyle, 2019b). The space sector is also growing as a market. It is estimated that it is currently worth about USD 350 billion, and according to various consulting companies, it should reach a value of between USD 1 and 2.7 trillion in 2040 (Foust, 2018).

The change in the sector means that the existing solutions, including the Space Treaty, are losing their significance (e.g., space mining cannot be reconciled with Article II of the Treaty), and the current geopolitical situation seems to exclude new, more adequate agreement that would be adapted to modern technologies. This situation, in turn, translates into more and more bolder violations of the existing laws, e.g., the already mentioned SPACE Act of 2015 or increasingly explicit orbital or suborbital weapons systems, which are clearly not developed “in the interest of maintaining international peace and security and promoting international co-operation and understanding” as it is stated in the Art. III of the Outer Space Treaty (UNOSA, 1967), as, e.g., the programs of Prompt Global Strike (CRS, 2019).

3. Outer Space as a Theatre for Potential Conflict

The progressive development of the space sector brings forth, as a natural consequence, the growth of its strategic importance. Every year we launch more and more satellites into the orbit. They are part of communication, navigation, reconnaissance, or security systems, which are used more and more and play an increasingly important role in the economy and security. Among many examples, one may point to the already mentioned Prompt Global Strike guidance system, the European Galileo navigation system, or Starlink - a constellation of satellites, which is expected to provide broadband internet for the entire globe and consist of approximately 42,000 satellites (SpaceX has already obtained a permission to launch 12,000 satellites, and in October 2019 the company asked the International Telecommunication Union to arrange spectrum for 30,000 new ones) (Henry, 2019).

On the other hand, there is a growing threat of the democratization of weapons capable of destroying satellite systems. According to the 2018 Worldwide Threat Assessment of the US Intelligence Community describes the space threat as one of the most significant ones (Coats, 2018, p. 13). ASAT The anti-satellite weapons (ASAT) are currently in possession of four countries – the United States, Russia, China, and, more recently, India. However, it is reported that other nation-states have the potential to develop direct-ascent (DA) ASAT systems on the basis of their ballistic missiles, e.g., Iran and North Korea (Weeden, Samson, 2019, pp. 4.1-2, 5.1-2), and some believe that Israel’s Arrow 3 missile has been developed to gain such a capability (Opall-Rome, 2009). There are many indications that this technology will eventually also be available to traditionally weak actors who will acquire it through purchase or by developing their own systems. As it was already mentioned, the space sector is growing by leaps and bounds. National-states and private entities that did not invest much or at all in the space industry before are now developing launching technologies (e.g., New Zealand, Norway, Poland), what, as a consequence, must lead to the democratization of the technology. What is more, in addition to traditional groundspace or air-space ASAT missiles, new types of that kind of weapon can be developed (potentially it could also become available for traditionally weak actors), such as small kamikaze satellites1 , cyber-hacking involving redirecting the object to a cloud of cosmic debris leading to its destruction or a weapon system that would be capable of “blinding” the satellite or destroy its sensors without physically destroying the object.

Considering the above facts, it should not come as a surprise that in order to ensure the operability of increasingly important, also for national security, satellite systems, there are programs being implemented to create offensive and defensive systems for objects in orbit. And that, in turn, has generated the construction of countermeasures – weapons that would be able to neutralize the new systems – by the potential adversaries. As a consequence, we are witnessing an expansion of the potential conflict arena where outer space becomes a possible theatre for military operations. This process is still in its early stages, but there should be no doubts that it is taking place already. Countries with sufficient technological potential caring for their current and future interests have been developing and will continue working on defensive systems (also aimed at eliminating the threat from traditionally weak actors) and offensive systems (ensuring military superiority and deterrence factor). Space corps are established and developed for exactly these purposes.

There is no indication that this process will stop. On the contrary, it seems that due to the progressive development of space technologies and the privatization of the sector, as well as substantial potential revenues from space mining or the global satellite broadband internet system, it will accelerate. As it was demonstrated in the section dedicated to the legal framework of operating in outer space, the current laws and treaties have lost their significance, and they are not taken into account while planning future operations. The United Nations and its Office for Outer Space Affairs (UNOOSA) are structurally and legally too weak to inflict punishment or sanction for breaking the rules. One may then risk the claim that further militarization of space is inevitable. It will undoubtedly further affect the validity of the Outer Space Treaty, which, over time, will not be respected at all. That, in turn, will open the door to the development of various kinds of space offensive weapon systems.

4. Militarization of Outer Space Is Imminent

The main argument of the paper provides the information why there will be a progressive increase of weapon systems placed in orbit, and various types of space corps will be further developed by national-states.

As was demonstrated above, we, as humankind, rely more and more on orbital communication, navigation, and security systems. Global and regional navigation satellite systems are continually developed and perfected by a progressive number of entities, mainly national states. Examples of GNSS include Europe’s Galileo, the US’s NAVSTAR Global Positioning System (GPS), Russia’s Global’naya Navigatsionnaya Sputnikovaya Sistema (GLONASS) and China’s BeiDou Navigation Satellite System. There are, however, another two regional systems under development, i.e., Indian Regional Navigation Satellite System (IRNSS) and Japanese Quasi-Zenith Satellite System (QZSS). All of those satellites, apart from securing civil safety (e.g., in transportation, logistics, communication), play a crucial role in national security.

Another example is the mentioned already Starlink system that will provide broadband internet for the Northern US and parts of Canada already in 2020, and the plan is to create the global system before 2027 (Mosher, 2019). Again, the system, although designed for civil purposes, will be used by the military – the US Air Force is testing SpaceX’s Starlink technology in military aircraft to deliver high bandwidth into the cockpit of Air Force planes under a program called Global Lightning (Malik, 2019). The facts are straightforward – there are more and more satellite systems that play an essential role in countries’ security and are part of critical infrastructure, so in order to secure their interests and protect that infrastructure, these national states keep developing both defensive and offensive means. The Worldwide Threat Assessment of the US Intelligence Community is very clear in its predictions in this regard:

We assess that, if a future conflict were to occur involving Russia or China, either country would justify attacks against US and allied satellites as necessary to offset any perceived US military advantage derived from military, civil, or commercial space systems (Coats, 2018).

However, we must not forget about the democratization of the weapon systems that may pose a serious and real threat to satellite systems. Currently, there are four countries in possession of the ASAT weapons that could destroy a satellite in orbit. However, more and more entities, both national states and private companies have been working on their launch technologies, like New Zeeland, Norway, Poland, just to name a few. Moreover, it should be remembered that not only ASAT missile systems may be used to attack and destroy satellites – one may use small kamikaze satellites to crash into the target, cyber-hacking to direct the object into the cloud of space debris, “blinding” the satellites with ground-based lasers (Mizokami, 2019). These technologies are much more reachable. Therefore, in time, we should expect that traditionally weak actors, like rogue states or terrorist organizations, will gain have access to them (Bernat, Posluszna, 2018).

#### China, Russia, and the US are developing dual use co-orbital ASATs that can stalk and attack other satellites using rendezvous and proximity operations – they make miscalculation highly likely

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Abstract

Since 2008, China has been developing a new co-orbital antisatellite weapon (ASAT). These “space stalkers” could be placed on orbit in peacetime and maneuvered to tailgate US satellites during a crisis. At a moment’s notice, they could simultaneously attack multiple critical satellites from such close proximity that the United States would not have time to prevent damage. Current national security space strategy, existing and developing space defense capabilities, and current proposals for dealing with weapons in space cannot counter this new threat. Since space stalkers cannot be reliably distinguished from ordinary satellites, these ASATs cannot be banned outright. Instead, this article proposes to ban threatening positioning of space objects, whether satellites or space stalkers. As these positions can be observed by multiple countries, the United States should declare and work with the international community to agree that any country configuring and readying space stalkers for attack demonstrates hostile intent, which justifies preemptive self-defense as the last resort. In the case of space stalkers, self-defense is a justified action rather than a pretext for aggression. The proposed scheme would be effective in deterring and defending against space stalkers.

The United States has 554 operational satellites, the largest number of satellites among all countries and organizations in the world (see table 1).1 While these space capabilities offer great advantages for the US military, they simultaneously create great vulnerabilities. The Department of Defense (DOD) is increasingly concerned, particularly about the space threat from China. In its annual reports to Congress, Military and Security Developments Involving the People’s Republic of China for 2013,2 2014,3 2015,4 and 2016,5 the DOD has warned repeatedly: “PLA [People’s Liberation Army] writings emphasize the necessity of ‘destroying, damaging, and interfering with the enemy’s reconnaissance . . . and communications satellites,’ suggesting that such systems, as well as navigation and early warning satellites, could be among the targets of attacks designed to ‘blind and deafen the enemy.’ ” Gen John Hyten, the former head of Air Force Space Command, said without space assets, the United States would be forced to revert to industrial age warfare: “It’s Vietnam, Korea and World War II”—no more precision missiles and smart bombs.6 Hyten was also quoted as saying that “China will soon be able to threaten US satellites in every orbital regime, from low Earth orbit a few hundred miles above the Earth, to geosynchronous orbit more than 20,000 miles up—where some of the military’s most important satellites circle the Earth. . . . Now we have to figure out how to defend those satellites.”7

As threats from ground-based ASATs (such as traditional threats from ballistic missiles, lasers, and jammers and the newer cyber attacks8 ) grow, it is easy to continue focusing on these much more well-known ASATs and ignore China’s developing co-orbital ASAT—hereafter what this article refers to as space stalkers. In November 2015, the U.S.-China Economic and Security Review Commission released its annual report to Congress stating that “since 2008, China has tested increasingly complex space proximity capabilities.”9 It confirmed what it and others have been suggesting, that “China’s recent space activities indicate it is developing co-orbital antisatellite systems to target US space assets. These systems consist of a satellite armed with a weapon such as an explosive charge, fragmentation device, kinetic energy weapon, laser, radio frequency weapon, jammer, or robotic arm.”10 Space objects capable of rendezvous proximity operations and particularly equipped with a robotic arm could pose a game-changing threat as these objects could be placed in orbit during peacetime. During a crisis, such as China seizing Taiwan or territorial disputes in the South China Sea, these space objects could be maneuvered to tailgate US satellites and become space stalkers. They could simultaneously attack multiple critical satellites from such a close proximity that the United States would not have time to react. The space stalkers could destroy enough critical satellites to force the United States back toward General Hyten’s warning of fighting primitive “industrial age warfare” with greatly increased collateral damage. On 29 November 2016, CNN broadcast the documentary “War in Space: The Next Battlefield,” based on interviews of more than 10 high-ranking military personnel of the entire chain of command for space warfare. These interviews described the concerns of senior space officials about the threat from “kamikaze and kidnapper satellites launched by Russia and China.”11

Geosynchronous satellites have long been considered safe from attacks, especially simultaneous attacks, since direct-ascent ASAT ballistic missiles would typically take about four hours to reach geosynchronous satellites.12 However, these satellites could soon be under serious threat. Setting up the space stalkers to be co-orbital with, and in close proximity to, their prey is the easiest way to coordinate simultaneous attacks. If China could place these highly maneuverable space stalkers in close proximity to multiple US critical satellites, simultaneous attacks would be possible with little advance warning, leaving the United States inadequate time to save the targeted satellites.

The space-stalking threat is unique and cannot be mitigated by focusing on and responding to traditional satellite threats. Even if the United States could perfectly deter and defend against all the traditional ASAT threats and the newer cyber attacks, adversaries could still use multiple stalkers to mount a devastating first strike against critical US satellites. Thus, the United States must specifically deal with the emerging spacestalker threat. This article provides analysis and recommendations on how to develop an overarching strategy to deter and defend against space stalkers without ignoring other threats and while gaining international support for the new strategy.

One must first understand Chinese counterspace strategy to prescribe an effective US strategy and policy. The United States must also refocus its traditional space policies to address the emerging space-stalking threat— something neglected today. Additionally, the National Security Space Strategy must be updated to include a strategy to defend against and to deter space stalkers, including justified preemption as the last resort. Diplomacy alone with potential adversaries to lessen the space-stalking threat is important but not sufficient. Therefore, the new US strategy should include developing new international agreements on weapons in space and in particular space stalkers.

The space-stalker threat does not come from China alone. Russia has also been improving its close proximity operation capability, which is dual-use for non-ASAT and ASAT purposes. Its potential space-stalking capability would be more advanced than China’s.13 However, this article uses only Chinese scenarios since concerns about the threat and suggested measures for US response are essentially the same for both China and Russia.

#### Unknown legal thresholds for escalation make inadvertent escalation highly likely

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Another dimension of the problem is the issue of the scale of the attack, both qualitatively and quantitatively. While jamming one or two satellites in isolation appears unlikely to quickly escalate into all-out space war (given the longstanding role of electronic warfare in past conflicts), attacking multiple intelligence-gathering satellites would carry a far higher risk of escalation. Somewhere between these two extremes, however, is an uncertain and unknowable boundary that divides offensive space actions that modestly threaten stability from those that are clearly destabilizing and escalatory. In this unpredictable environment, a country with no desire to spark an all-out space war may still prompt rapid escalation with modest offensive actions that inadvertently cross an unknown threshold. In addition, for technological, commercial, and other reasons the space and cyber domains are evolving far more rapidly than the conventional and nuclear domains, potentially rendering space and cyber strategies ineffective or irrelevant within a few years. In both space and cyberspace, we may learn firsthand how much escalation is too much only after it is too late to stop. Evolving space dynamics could undermine whatever current understanding we may have of crisis and strategic stability in space, and this imperfect grasp of general principles can only add to our uncertainty about the space and cyber offensive capabilities of particular adversaries. Therefore, uncertainty, bluffs, and worst-case thinking are bound to remain prominent forces in the strategic landscape of space. For example, rendezvous and proximity operations on satellites will become more common in the years to come, but they could easily be viewed in a crisis as potentially hostile acts—or in fact be used to commit hostile acts.

## Framing

#### The standard is maximizing expected wellbeing.

#### 1] Actor spec –

#### A] Aggregation – every policy benefits some and harms others, which also means side constraints freeze action.

#### B] No intent-foresight distinction – If we foresee a consequence, then it becomes part of our deliberation which makes it intrinsic to our action since we intend it to happen.

#### 2] Death is bad and outweighs – a] agents can’t act if they fear for their bodily security which constrains every ethical theory, b] it destroys the subject itself – kills any ability to achieve value in ethics since life is a prerequisite which means it’s a side constraint since we can’t reach the end goal of ethics without life

#### 3] Extinction outweighs – magnitude, irreversibility, uncertainty.

MacAskill 14 [William MacAskill, Associate Professor in Philosophy and Research Fellow at the Global Priorities Institute, University of Oxford, “Normative Uncertainty,” 2014, University of Oxford PhD Thesis, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.677.4121&rep=rep1&type=pdf]

However, even if we believe in a moral view according to which human extinction would be a good thing, we still have strong reason to prevent near-term human extinction. To see this, we must note three points. First, we should note that the extinction of the human race is an extremely high stakes moral issue. Humanity could be around for a very long time: if humans survive as long as the median mammal species, we will last another two million years. 188 On this estimate, the number of humans in existence in the future, given that we don’t go extinct anytime soon, would be 2×10^14. 189 So if it is good to bring new people into existence, then it’s very good to prevent human extinction.

Second, human extinction is by its nature an irreversible scenario. If we continue to exist, then we always have the option of letting ourselves go extinct in the future (or, perhaps more realistically, of considerably reducing population size). But if we go extinct, then we can’t magically bring ourselves back into existence at a later date.

Third, we should expect ourselves to progress, morally, over the next few centuries, as we have progressed in the past. So we should expect that in a few centuries’ time we will have better evidence about how to evaluate human extinction than we currently have.

## Underview

#### 1AR theory –

#### ---A] AFF gets it because otherwise the neg can engage in infinite abuse, making debate impossible. No 2n theory – kills resolvability because judge has to intervene in weighing interp and 2ar counterinterp.

#### ---B] drop the debater – the short 1AR irreparably skewed from abuse on substance and time investment on theory.

#### ---C] no RVIs – the 6-minute 2nr can collapse to a short shell and get away with infinite 1nc abuse via sheer brute force and time spent on theory.

#### ---D] Use competing interps – 1AR interps aren’t bidirectional and the neg should have to defend their norm since they have more time.

#### Yes Aff RVIs

#### ---A] I have a 4 minute 1AR to answer T or Theory which skews my time from other arguments. T bites out of a higher percentage of my rebuttal time.

#### ---B] No risk issue for the negative, you can go for it in the 2nr if I undercover but if I overallocate you can just kick it.

#### Fairness is a voter – debate is a competitive activity and needs both debaters to be on an equal playing field argumentatively.