# AC (Leo)

#### I affirm the Resolved: The appropriation of outer space by private entities is unjust.

#### My sole contention is that companies going into outer space will increase space debris, which is bad.

#### Increasing debris triggers something called the Kessler Syndrome -- when space junk has proliferated so much that space becomes practically unusable. While we’re safe for now, private entities plan to increase debris exponentially through mass launches of satellites called ‘mega-constellations.’

Kelvey 22 (Kelvey, Jon. “Kessler Syndrome: How Runaway Space Junk Could Trap Humans on Earth.” Inverse, Inverse, 3 Jan. 2022, https://www.inverse.com/science/what-is-kessler-syndrome. [Jon Kelvey is a science writer covering space, aerospace, and biosciences. His work has appeared in publications such as Air & Space Magazine, Earth and Space News, Slate, and Smithsonian in addition to Inverse. Kelvey studied cognitive neuroscience at UC Berkeley and prior to a career in journalism worked in the California wine industry, in construction as an electrician, and as a motel housekeeper.])//LK [Accessed 1/27/22]

When you’re screaming through the void faster than a speeding bullet, any traffic you encounter might as well be made of, well, speeding bullets. Defensive driving is recommended. Hazardous space debris has twice threatened the International Space Station recently. On or around November 12, a debris field generated by a Russian military anti-satellite missile, or ASAT test, sent ISS crew members — including Russian cosmonauts — to shelter in the station’s Dragon and Soyuz spacecraft in case they needed to evacuate, while on December 2, the station maneuvered around a chunk of a defunct American Pegasus rocket. No one was hurt in either case, and the risks were hardly novel — the ISS has maneuvered around space debris more than 30 times since 1999. But it’s also a problem that’s almost guaranteed to worsen given worrying trends in the militarization of space and the fact that all signs point to ever more objects being launched into space every year. Take into consideration mega-constellations like SpaceX’s Starlink, for which “the plan is to launch 100,000 active satellites in the next few years,” Jonathan McDowell, a Harvard astrophysicist who has been tracking satellites on the side for more than a decade, tells Inverse. “The collision rate grows as the square of the number of satellites. If you have 10 times as many satellites, you will have 100 times as many collisions.” And the thing is, space debris is not simply the detritus of old space missions. A satellite stricken by orbital debris becomes debris itself, which can then hit another satellite, creating debris that can strike another, and so on. It’s a chain reaction known as Kessler Syndrome, and while it doesn’t take place in the half-hour time frame as dramatized in the movie Gravity, the result may be the same: no more outer space for anybody. “At least some models suggest that, yeah, it's already underway,” McDowell says, “it's just going to take a century to play out.” Space Junk basics It’s a good thing the sky is so big, because humans have flung a lot of things up there. And every bit of it, from large spacecraft to tiny pieces of cloth, are careening around at 17,500 miles-per-hour or faster. At those speeds, even collisions between somewhat small objects can be catastrophic. “The unit I like to use is a megajoule, which is the kinetic energy of a one-ton truck hitting you at 100 miles an hour,” McDowell says. Collisions between small satellites can generate tens of thousands of megajoules of kinetic energy, while even tiny pieces of debris still pack enough of a punch to drill bullet holes in the ISS and other space assets. The Hubble Space Telescope carries a Whipple shield, for instance, a sort of bulletproof vest to absorb the energy of more minor debris impacts. hubble micrometeroid shield The radiator shield from Hubble’s Wide Field Planetary Camera II, as seen at the National Air and Space Museum. Each hole is where NASA drilled to find debris fragments. John Wenz It’s an imperfect solution, “smaller” being relative and “big” being game over. “If you get hit by a big enough piece of debris, [a Whipple shield] is not gonna be enough,” McDowell says. “And if something comes down the telescope aperture and hits the Hubble mirror, that’s also not good.” The good news is that organizations that track debris, such as the US Space Command, have a pretty good handle on the big stuff in orbit — anything from multi-ton dead satellites to debris 10 centimeters across. “The trackable debris we follow as individual objects, and we’re tracking about 40,000 objects, of which 5,000 or so are working satellites and the rest is junk,” McDowell says. “If you look at stuff down to just one centimeter, there’s probably a million of those. But we don’t really know because they’re too small.” There are two main sources of space debris at the moment, the primary being old rocket stages still in orbit decades after the delivery of their payload. “The fuel and the oxidizer get together because the seals fail,” McDowell says, “And they go bang.” The secondary source is military anti-satellite tests, he says, which generate debris clouds that can persist for decades. But if a Kessler Syndrome cascade is already underway, and continues apace unmitigated, eventually the most significant source of space debris will be the pulverized remains of satellites, spacecraft, and space stations dashed upon rocks of our own making. A history of space junking and space punking Putting aside the occasional meteor shower, space debris is an entirely human creation — satellites don’t launch themselves. But not all space debris is created equally. Many objects are merely byproducts of early space exploration, while the birth of others was more intentional. For example, while Russia has drawn international criticism for its ASAT test in November, in the early 1960s, it was the Soviet Union who accused the United States of purposefully polluting the spaceways. Between 1961 and 1963, the United States launched almost half a billion copper needles into low-Earth orbit, Caltech historian of technology Lisa Ruth Rand tells Inverse. Called Project West Ford, it was an attempt to create an artificial ionosphere for long-range radio communications in case a US-USSR nuclear war disrupted other means. The Soviets were not amused, and accused the US of “trying to destroy all space so that no one else could use it, out of spite,” Rand says. Both the Soviet Union and the United States developed and tested anti-satellite missile technologies in the 1970s and 80s, creating orbital debris and leading to a lull in ASAT tests until 2007, when China used an ASAT to destroy an old weather satellite. The US used an ASAT missile to destroy a spy satellite that failed after its launch in 2008, and India launched a small satellite in January of 2019 only to shoot it down with an ASAT in March 2019. The next and most recent ASAT test to actually destroy a satellite in space was the Russian test in November, and all four of the tests created debris, some of which will remain in orbit for years to come. “Most of the debris from the Russian ASAT will be down on a timescale of like five years, and the rest of it will be down on the timescale of 10 to 20 years, which, it’s still not good,” McDowell says. “For the Chinese ASAT, which was up at a higher altitude, more like 900 kilometers, some of that debris is likely going to be up there for many decades.” Such intentional creation of space debris seems irrational and irresponsible given how problematic incidental space debris already is. A 2009 collision between an Iridium communications satellite and a defunct Russian satellite over Siberia first turned Rand on to studying space debris as a research focus while in grad school, and for every impact, there are many more close calls. In 2012, for instance, a defunct Soviet Kosmos satellite threatened the Fermi Gamma-ray Space Telescope and presented its operators with a tough decision, Rand says. “Either light up thrusters that had been dormant for years, that were cold and could blow the whole works,” or hope the debris would pass further from Fermi than projected, such predictions always coming as probabilities rather than certainties. She says that the operators ultimately opted to risk using the thrusters, and the space telescope moved, and all was fine, but it was still a risky situation. And such situations are not always improved when all satellites involved are still live and operational. In September 2019, Rand says, a Starlink satellite and an ESA satellite almost collided when operators at SpaceX failed to check their email and missed some urgent missives from their counterparts at ESA. And over the summer of 2021, McDowell recently tweeted, the Chinese space station twice dodged Starlink satellites that may have passed within 1 kilometer of the station. “These are the kinds of close calls are happening a lot and increasingly more as the number of objects in outer space increases,” Rand says. “The number of functioning satellites in space is just exploding. It’s huge. It’s getting bigger and bigger every day.” What is Kessler Syndrome and why does it matter? In some ways, the Kessler Syndrome is like a slow-moving zombie apocalypse. (In George Romero’s classic Night of the Living Dead, Rand notes, it’s theorized a contaminated satellite returning from Venus triggers the zombie rise.) The space debris chain reaction converts otherwise operational space assets into further navigational hazards. “It’s an unwanted weaponizing of a valuable object into something that becomes dangerous,” Rand says. Had the Fermi telescope thrusters failed, “that would have been the loss of a major scientific instrument and cultural heritage artifact that had become a series of projectiles.” And the threat of losing space assets means the Kessler Syndrome has a costly impact long before the chain reaction has progressed enough to prevent access to space. More satellites in space mean more potential collisions, which means more satellites — and space stations — making more frequent evasive maneuvers to avoid further collisions, all of which can interrupt operations and cost operators money by decreasing the lifespan of their satellites. Every Starlink satellite has a limited amount of krypton propellant onboard for maneuvering around debris and Chinese space stations, for instance, and when the tank is near empty, it’s time for that satellite’s long fiery goodbye bow in the upper atmosphere — failure to do so just increases the problem by adding another dead satellite. “Space is big,” Rand says, “but once things start to collide, it becomes rapidly small.” Rapidly, but not linearly. Unfortunately, if the Kessler cascade is already underway, it will take years to reach a point where it’s happening in what humans perceive as “real-time.” By then, it may be too late. “On a timescale of decades, you’ll have to dodge more and more often, and eventually you won’t be able to dodge anymore because the traffic is so bad,” McDowell says. Adding the caveat that it’s just his back-of-the-envelope math, he says, “we are probably exceeding the carrying capacity of low Earth orbit right now.” The consequence of full bore Kessler syndrome allowed to run its course would be to negate the sci-fi ambitions of people like Elon Musk. To proscribe humans from the cosmos and limit our future to that of a one-planet species for many lifetimes — physically and intellectually. The space debris could ruin ground-based astronomy, too, hemming in our minds as well as our rockets. “It would mean to basically close ourselves off from the rest of the cosmos,” Rand says. “That the endgame of the space age is not so much humanity becoming cosmopolitan, becoming multi-planetary, becoming part of the universe, but instead making it so that we just can’t leave anymore.” What can we do about space debris? There is some good news when it comes to space debris, beginning with the fact that there are some natural processes that help to clear the space lanes of the dead and dying detritus of human space fairing. The Sun goes through an 11-year cycle of solar storms that, at its peak, makes the Earth’s atmosphere a little denser, generating more drag on any objects orbiting in lower orbits. “So there’s sort of a cleaning cycle every 11 years of the lower atmosphere, the lower part of [low-Earth orbit] goes through,” McDowell says. “But in the upper part of [low-Earth orbit] that change is not enough to make a difference, and the stuff keeps orbiting.” On average, objects orbiting around 200 kilometers altitude will re-enter Earth’s atmosphere within a week or two without active boosting, he says. In comparison, objects orbiting at around 400 kilometers will re-enter within a year or two. By 550 kilometers altitude, things take 25 years or more to re-enter the atmosphere, McDowell says, and “above about 600 kilometers, because the air density falls off so quickly, stuff up there will stay up for centuries, for millennia.” These physical realities of orbiting objects considered, there are two major paths to dealing with space debris, and we have to walk both of them. First, we need to safely rid space of the most problematic pieces of space debris. Second, we need to stop making more of it. As to the first, the technical challenges are not as awesome as you might assume, once you accept that you’ll never clear space of all small debris and focus only on the worst offenders. “The leading term in growing the Kessler cascade is the big things hitting each other because they create so much extra debris,” McDowell says. Get rid of the 100 biggest objects — late dead satellites, old rocket stages — and it would reduce the rate at which the runaway is happening. But it’s not yet clear who will do such work, who will pay for it, and if it’s even legal. Unlike ocean salvage, where the Law of the Sea allows third parties to extract resources from abandoned ships or wrecks, spacefaring nations retain responsibility and authority over all objects they have placed in space under the Outer Space Treaty of 1967. “If you want to remove an old Soviet abandoned rocket stage, without causing an international incident, you have to get Russia’s permission,” McDowell says. Since the technology you would use to remove an old satellite could be used to take out a new one, “it’s a bit of a sensitive issue.” So removal of old space debris may require a lot of international negotiation and new agreements, which is just as well, given the same is necessary to tamp down on the addition of new space debris. The United Nations may soon discuss new proposals to ban the test or use of ASAT weapons, and the proposal may have more lift under its wings given the wind condemnation of Russia’s missile test in November. “The bright side is that we are starting to restart discussions about what are the right rules of the road in space,” McDowell says. “Maybe if people get alarmed enough that something will actually be done.”

#### And commercial space appropriation is soon to make the Kessler syndrome a certainty—the probability is high

#### 1] Large satellite constellations make management impossible

Boley/Byers, 5/20/2021 – University of British Columbia Professors

Aaron C. Boley is an associate professor and Canada Research Chair in Planetary Astronomy in the Department of Physics and Astronomy, Faculty of Science, at The University of British Columbia. I am also the co-director of The Outer Space Institute, a transdisciplinary organization that addresses challenges associated with NewSpace.

Michael Byers holds the Canada Research Chair in Global Politics and International Law. His work focuses on Outer Space, Arctic sovereignty, climate change, the law of the sea, the laws of war, and Canadian foreign and defence policy. Dr. Byers has been a Fellow of Jesus College, Oxford University, a Professor of Law at Duke University, and a Visiting Professor at the universities of Cape Town, Tel Aviv, Nord (Norway) and Novosibirsk (Russia).

Aaron C. Boley & Michael Byers, “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth”, Scientific Reports volume 11, Article number: 10642 (2021), 20 May 2021, <https://www.nature.com/articles/s41598-021-89909-7.pdf>, accessed 12/1/21, sb

Thousands of satellites and 1500 rocket bodies provide considerable mass in LEO, which can break into debris upon collisions, explosions, or degradation in the harsh space environment. Fragmentations increase the cross-section of orbiting material, and with it, the collision probability per time. Eventually, collisions could dominate on-orbit evolution, a situation called the Kessler Syndrome3. There are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraft and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the long-term evolution of debris suggest that LEO is already in the protracted initial stages of the Kessler Syndrome, but that this could be managed through active debris removal4. The addition of satellite mega-constellations and the general proliferation of low-cost satellites in LEO stresses the environment further5,6,7,8. Results The overall setting The rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defines NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with effects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph. Although the volume of space is large, individual satellites and satellite systems have specific functions, with associated altitudes and inclinations (Fig. 2). This increases congestion and requires active management for station keeping and collision avoidance9, with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, after failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency. When completed, Starlink will include about as many satellites as there are trackable debris pieces today, while its total mass will equal all the mass currently in LEO—over 3000 tonnes. The satellites will be placed in narrow orbital shells, creating unprecedented congestion, with 1258 already in orbit (as of 30 March 2021). OneWeb has already placed an initial 146 satellites, and Amazon, Telesat, GW and other companies, operating under different national regulatory regimes, are soon likely to follow. Enhanced collision risk Mega-constellations are composed of mass-produced satellites with few backup systems. This consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also considerable discarded equipment. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of de-orbiting satellites will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difficult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC (see “Methods”). The large density spikes show that some shells will have satellite number densities in excess of n=10−6 km−3. Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some companies might be less-than-fully transparent about events13 in LEO. Despite the congestion and traffic management challenges, FCC filings by SpaceX suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the filings do not account for untracked debris6, including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 after one year. Thus, if at any time there are 230 pieces of untracked debris decaying through the 550 km orbital shell, there is a 50% chance that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if subsequent fragmentation events lead to similar amounts of debris within that orbital shell, a runaway cascade of collisions could occur. Fragmentation events are not confined to their local orbits, either. The India 2019 ASAT test was conducted at an altitude below 300 km in an effort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. A major fragmentation event from a single satellite could affect all operators in LEO. Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation. One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

#### Starlink is responsible for HALF of all dangerous space near-collisions – full megaconstellation can make collisions ten times more likely and debris avoidance software doesn’t check

Pultarova, 8/18/2021 – journalist, quoting Europe’s leading space debris expert

Tereza is a London-based science and technology journalist, aspiring fiction writer and amateur gymnast. Originally from Prague, the Czech Republic, she spent the first seven years of her career working as a reporter, script-writer and presenter for various TV programmes of the Czech Public Service Television. She later took a career break to pursue further education and added a Master's in Science from the International Space University, France, to her Bachelor's in Journalism and Master's in Cultural Anthropology from Prague's Charles University. She worked as a reporter at the Engineering and Technology magazine, freelanced for a range of publications including Live Science, Space.com, Professional Engineering, Via Satellite and Space News and served as a maternity cover science editor at the European Space Agency. “SpaceX Starlink satellites responsible for over half of close encounters in orbit, scientist says”, August 18, 2021, <https://www.space.com/spacex-starlink-satellite-collision-alerts-on-the-rise>, accessed 12/1/21, sb

Operators of satellite constellations are constantly forced to move their satellites because of encounters with other spacecraft and pieces of space junk. And, thanks to SpaceX's Starlink satellites, the number of such dangerous approaches will continue to grow, according to estimates based on available data. SpaceX's Starlink satellites alone are involved in about 1,600 close encounters between two spacecraft every week, that's about 50 % of all such incidents, according to Hugh Lewis, the head of the Astronautics Research Group at the University of Southampton, U.K. These encounters include situations when two spacecraft pass within a distance of 0.6 miles (1 kilometer) from each other. Lewis, Europe's leading expert on space debris, makes regular estimates of the situation in orbit based on data from the Socrates (Satellite Orbital Conjunction Reports Assessing Threatening Encounters in Space ) database. This tool, managed by Celestrack, provides information about satellite orbits and models their trajectories into the future to assess collision risk. Lewis publishes regular updates on Twitter and has seen a worrying trend in the data that reflects the fast deployment of the Starlink constellation. "I have looked at the data going back to May 2019 when Starlink was first launched to understand the burden of these megaconstellations," Lewis told Space.com. "Since then, the number of encounters picked up by the Socrates database has more than doubled and now we are in a situation where Starlink accounts for half of all encounters." The current 1,600 close passes include those between two Starlink satellites. Excluding these encounters, Starlink satellites approach other operators’ spacecraft 500 times every week. In comparison, Starlink's competitor OneWeb, currently flying over 250 satellites, is involved in 80 close passes with other operators' satellites every week, according to Lewis' data. And the situation is bound to get worse. Only 1,700 satellites of an expected constellation of tens of thousands have been placed into orbit so far. Once SpaceX launches all 12,000 satellites of its first generation constellation, Starlink satellites will be involved in 90% of all close approaches, Lewis’ calculations suggest. The risk of collision Siemak Hesar, CEO and co-founder of Boulder, Colorado, based Kayhan Space, confirms the trend. His company, which develops a commercial autonomous space traffic management system, estimates that on average, an operator managing about 50 satellites will receive up to 300 official conjunction alerts a week. These alerts include encounters with other satellites as well as pieces of debris. Out of these 300 alerts, up to ten might require operators to perform avoidance maneuvers, Hesar told Space.com. Kayhan Space bases their estimates on data provided by the U.S. Space Surveillance Network. This network of radars and telescopes, managed by the U.S. Space Force, closely monitors about 30,000 live and defunct satellites and pieces of debris down to the size of 4 inches (10 centimeters) and provides the most accurate location data of the orbiting objects. The size of this catalog is expected to increase ten times in the near future, Hesar added, partly due to the growth of megaconstellations, such as Starlink, and partly as sensors improve and enable detection of even smaller objects. The more objects in the catalog mean more dangerously close encounters. "This problem is really getting out of control," Hesar said. "The processes that are currently in place are very manual, not scalable, and there is not enough information sharing between parties that might be affected if a collision happens." Hesar compared the problem to driving on a highway and not knowing that there has been an accident a few miles ahead of you. If two spacecraft collide in orbit, the cloud of debris the crash generates would threaten other satellites travelling through the same area. "You want to have that situational awareness for the other actors that are flying in the neighbourhood," Hesar said. Bad decisions Despite the concerns, only three confirmed orbital collisions have happened so far. Earlier this week, astrophysicist and satellite tracker Jonathan McDowell, who's based at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, found evidence in Space-Track data that the Chinese meteorological satellite Yunhai 1-02, which disintegrated in March this year, was actually hit by a piece of space debris. The worst known space collision in history took place in February 2009 when the U.S. telecommunication satellite Iridium 33 and Russia's defunct military satellite Kosmos-2251 crashed at the altitude of 490 miles (789 kilometres). The incident spawned over 1,000 pieces of debris larger than 4 inches (10 cm). Many of these fragments were then involved in further orbital incidents. Lewis is concerned that with the number of close passes growing, the risk of operators at some point making a wrong decision will grow as well. Avoidance maneuvers cost fuel, time and effort. Operators, therefore, always carefully evaluate such risks. A decision not to make an avoidance maneuver following an alert, such as that made by Iridium in 2009, could, however, clutter the orbital environment for years and decades. "In a situation when you are receiving alerts on a daily basis, you can't maneuver for everything," Lewis said. "The maneuvers use propellant, the satellite cannot provide service. So there must be some threshold. But that means you are accepting a certain amount of risk. The problem is that at some point, you are likely to make a wrong decision." Hesar said that uncertainties in the positions of satellites and pieces of debris are still considerable. In case of operational satellites, the error could be up to 330 feet (100 meters) large. When it comes to a piece of debris, the uncertainty about its exact position might be in the order of a mile or more. "This object can be anywhere in this bubble of multiple kilometres," Hesar said. "At this point, and for the foreseeable future, avoidance is our best recourse. People that say 'I'm going to take the risk', in my humble opinion, that's an irresponsible thing to do." Starlink monopoly Lewis is concerned about the growing influence of a single actor — Starlink — on the safety of orbital operations. Especially, he says, as the spaceflight company has entered the satellite operations world only recently. "We place trust in a single company, to do the right thing," Lewis said. "We are in a situation where most of the maneuvers we see will involve Starlink. They were a launch provider before, now they are the world's biggest satellite operator, but they have only been doing that for two years so there is a certain amount of inexperience." SpaceX relies on an autonomous collision avoidance system to keep its fleet away from other spacecraft. That, however, could sometimes introduce further problems. The automatic orbital adjustments change the forecasted trajectory and therefore make collision predictions more complicated, according to Lewis. "Starlink doesn't publicize all the maneuvers that they're making, but it is believed that they are making a lot of small corrections and adjustments all the time," Lewis said. "But that causes problems for everybody else because no one knows where the satellite is going to be and what it is going to do in the next few days."

#### 2] Mining – masses of dust, sublimation, and other causes are contributing factors.

Boley and Byers 20 (Arron, Department of Physics and Astronomy, University of British Columbia; Michael, Department of Political Science, University of British Columbia) U.S. policy puts the safe development of space at risk, SCIENCE, 9 Oct 2020, Vol 370, Issue 6513, pp. 174-175 <https://www.science.org/doi/full/10.1126/science.abd3402> EE

Mining can generate serious operational concerns. Lunar dust is a known challenge to operations on the Moon. Any surface activity could exacerbate lunar dust migration, including by lofting dust onto trajectories that cross lunar orbits, such as that of NASA's proposed Lunar Gateway (11). Moreover, without cooperation by all actors, the limited number of useful lunar orbits could quickly become filled with space debris.

On asteroids, low escape speeds will make it difficult to prevent the loss of surface material. Even if full enclosures are used, waste material may be purposefully jettisoned. Mining could also lead to uncontrolled outbursts of volatile sublimation after the removal of surface layers. Because the asteroids targeted for mining are likely to be those with small minimum orbit intersection distances, the resulting meteoroid debris streams could threaten lunar operations as well as satellites in Earth's orbit (12). In a worst-case scenario, a trajectory change resulting from mining could eventually lead to an Earth-impact emergency.

Space missions already provide some evidence of these risks. In 2019, during the course of Japan's Hayabusa2 mission, a small impactor was used to make a crater on (162173) Ryugu (13). Some of the resulting anthropogenic meteoroids could begin reaching Earth during the 2033 apparition. In 2022, NASA will test its ability to deflect an asteroid by striking (65803) Didymos B (Dimorphos) with the Double Asteroid Redirection Test spacecraft. This impact will produce anthropogenic meteoroids, with the possibility of immediate delivery to Earth (14). Although these risks are small, they demonstrate how easily human actions can change the near-Earth environment.

#### Next is the impacts—

#### 1] Public satellites that get destroyed during Kessler are key to fighting climate change—monitoring emissions and enforcement of climate policy

Bender and Custodio 21 (Bender, Bryan, and Jonathan Custodio. “'It Is a Game Changer': Waging War on Climate Change from Space.” POLITICO, POLITICO, 4 Nov. 2021, [https://www.politico.com/news/2021/10/31/climate-change-space-satellites-517773. [Bryan Bender is a senior national correspondent for POLITICO, where he focuses on the Pentagon, NASA, and the defense and aerospace industries. He was previously the national security reporter for the Boston Globe, where he covered U.S. military operations in the Middle East, Asia, Latin America, and the Balkans. He also writes about terrorism and government secrecy. He is an adjunct professor at the Walter Cronkite School of Journalism at Arizona State University and the author of “You Are Not Forgotten,“ the story of an Iraq War veteran’s search for a missing World War II fighter pilot in the South Pacific. Jonathan Custodio is a POLITICO fellow currently reporting for the energy team. Past POLITICO experience includes a three-month rotation on World and National Security and an internship in the New York office, where he contributed regularly to New York Playbook and the New York Real Estate newsletter and covered city campaigns.])//LK](https://www.politico.com/news/2021/10/31/climate-change-space-satellites-517773.%20%5bBryan%20Bender%20is%20a%20senior%20national%20correspondent%20for%20POLITICO,%20where%20he%20focuses%20on%20the%20Pentagon,%20NASA,%20and%20the%20defense%20and%20aerospace%20industries.%20He%20was%20previously%20the%20national%20security%20reporter%20for%20the%20Boston%20Globe,%20where%20he%20covered%20U.S.%20military%20operations%20in%20the%20Middle%20East,%20Asia,%20Latin%20America,%20and%20the%20Balkans.%20He%20also%20writes%20about%20terrorism%20and%20government%20secrecy.%20He%20is%20an%20adjunct%20professor%20at%20the%20Walter%20Cronkite%20School%20of%20Journalism%20at%20Arizona%20State%20University%20and%20the%20author%20of%20) [Accessed 1/27/22]

The battle against climate change — and to mitigate some of its most deadly effects — is increasingly being waged from space. Satellites are measuring the rate of icebergs calving into the Arctic Ocean and outbreaks of phytoplankton from rising water temperatures and pollution. Soon, they will be used to “persistently pinpoint” the amount of methane and carbon dioxide spewing from factories and power plants most responsible for supercharging the planet. As President Joe Biden and other world leaders gather in Scotland this week for the United Nations’ annual climate change conference, the new space age has armed them with some of the best tools yet to diagnose climate change and gauge whether their policies to reverse it are working. “Satellites were absolutely key in understanding we had a climate crisis,” said Krystal Azelton, director of space applications programs at the Secure World Foundation, a nonprofit Washington, D.C., think tank. “We are seeing vast improvements … in data sharing and access” and “the push to have open access to government data around the world is huge.” The surge in new constellations of optical and radar satellites are also now making it possible to limit some of the damage of climate change — by predicting the trajectories of forest fires, measuring soil saturation to reduce flooding and detecting radio signals in remote regions to uncover illicit deforestation or mining. An aerial photograph shows flooding in Kentucky. Satellite images were used to help measure the extent of flooding in Stanton, Kentucky, last spring. | Courtesy of Planet An aerial photograph shows flooding in Kentucky. Satellite images were used to help measure the extent of flooding in Stanton, Kentucky, last spring. | Courtesy of Planet A top priority Biden, who arrives Monday in Glasgow, has made greater reliance on space technologies a major pillar of his ambitious agenda to tackle the climate crisis. One new effort is NASA’s Earth System Observatory program to “create a 3D, holistic view of Earth, from bedrock to atmosphere.” Biden’s first annual budget request for NASA also sought $24.8 billion, including a $2.25 billion for the Earth Science Division, a 12.5 percent boost. And he requested $6.98 billion, or a 22 percent increase, for the National Oceanic and Atmospheric Administration, which operates an extensive constellation of weather satellites. That includes a proposed 25 percent increase for NOAA’s National Environmental Satellite, Data, and Information Service. Biden’s budget proposals have been moving slowly through Congress since they were introduced in May. The NASA budget proposal has been approved by the House Science subcommittee and Senate appropriators, with increases of $240 million and $35.8 million, respectively. NOAA would get nearly $6.3 billion under the Senate appropriations bill and the House Appropriations committee approved a $6.46 billion budget. Rep. Eddie Bernice Johnson (D-Texas), chair of the House Science Committee, backed strong investments in space and Earth observation, while leaving the door open for federal government and private sector collaboration. “The challenge of the climate crisis certainly requires that we examine every opportunity to leverage capabilities and build or enhance partnerships across the government and private sectors,” Johnson said. “One area we are continuing to consider is how to ensure open public access for any commercially provided data by our federal science agencies.” Meanwhile, the National Space Council, the Cabinet-level body headed by Vice President Kamala Harris, has also made improving “our indications and warning of climate change” a priority for the nation’s space agenda. Using satellites to understand changes in the environment is not new; NASA’s first effort to gather facts about natural resources from orbit, as opposed to measuring the weather in the atmosphere, was the launch of the first Landsat satellite in 1972. Now, there are a variety of space-based means available on the commercial market to do it with far more accuracy and frequency. A climate census From September 2011 to August 2020, the number of commercial satellites designed to capture high-resolution images or detect heat or other invisible signatures jumped from 10 to 338, according to the Union of Concerned Scientists, which updates its list several times a year. POLITICO used the final update of each year for the tally. In the most recent update released in May, there were 450 commercial satellites used for earth observation. “The only way to really get a global view is from satellites,” said Walter Scott, chief technology officer at space technology company Maxar Technologies. “You need to be able to make observations over a longer period of time, to be able to see trends that are in fact climate as opposed to local variations in weather.” The tools now available, however, are akin to being able to analyze census data by neighborhood instead of just at the regional or national levels. One class of targets is what climate scientists call “heat islands,” or urbanized areas that experience higher temperatures than outlying areas, which can be better analyzed with higher resolution imaging. “There are things that are happening on very small scales, urban scales,” said Vernon Morris, an atmospheric and climate scientist at Arizona State University. “The ability to gather this granularity of data, so often, is probably the biggest difference,” agreed Matt Tirman, head of Satellogic North America, a division of the Argentine company founded in 2010 that operates a constellation of satellites that can also capture live-motion video. “I do think it is a game changer,” added Morris. An aerial photograph of a glacier in Alaska is shown. Satellite images show changes over time in the Columbia Glacier in Alaska. | Courtesy of Planet An aerial photograph of a glacier in Alaska is shown. Satellite images show changes over time in the Columbia Glacier in Alaska. | Courtesy of Planet Planet, an Earth observation company founded in 2010, recently partnered with NASA’s Jet Propulsion Lab, the state of California and a group of nonprofits to create the Carbon Mapper, which will use its satellites to scan the globe daily for emissions of damaging substances like methane — an invisible, odorless and powerful greenhouse gas. “It will be able to see that it's that building, and that oil pad, and that landfill that are responsible for methane leaks,” said Andrew Zolli, Planet’s chief impact officer. “This is the incredibly sensitive — what we call point source emissions detector.” Another similar effort is Climate TRACE, a collection of scientific institutions that is using Earth observation data to monitor coal-fired power plants. “They are looking at the coal plant and the coal that is flowing through the plant to determine if it is operating,” Zolli said. Another new set of tools is radar satellites that can monitor environmental changes in the Arctic or mountainous regions that are often obscured by clouds and darkness, major limitations for optical satellites. An aerial image shows a rockslide in New Zealand. A large rockslide on Mount Silberhorn in New Zealand is tracked from space. | Courtesy of Planet For instance, ICEYE, a Finnish company founded in 2014, is monitoring floating ice in the Nares Strait near Greenland and the Thwaites Glacier in Antarctica. The new tools are “of great importance especially for small-scale glacier monitoring,” said Eric Jensen, president of ICEYE US, its American subsidiary, Satellites outfitted with synthetic aperture and hyperspectral radars, meanwhile, have “an influence on our ability to better understand wildfires and what causes them and how they can be addressed,” said Azelton. Minimizing the damage Indeed, the growth of satellite imagery and data is providing new means to head off some of the more calamitous effects of climate change. “The ability to observe, which can ultimately lead to the ability to predict, is really what prepares us for hazards and helps us mitigate the disasters that they can lead to,” said Karen St. Germain, director of NASA’s Earth Science division. She noted that satellites can examine the trajectory of forest fires in real time and identify burn scars that cause landslides. “Vegetation is what holds the soil together,” she explained. “So, if the area’s burned and then the precipitation comes, that's when you can get landslides and cascading effects.” ICEYE’s radar satellites can also be used to quickly identify downed or damaged power lines, responsible for starting thousands of forest fires, so that crews can respond before it’s too late. Satellites are also assisting in the aftermath of climate-related natural disasters. Maxar aided several nongovernmental organizations in identifying safe sources of drinking water, accessible transportation routes, and even potentially trapped families after a destructive 2018 earthquake in Indonesia. An aerial photograph shows the Dixie Fire in California. California’s Dixie forest fire earlier this year burned across five counties and grew into the single largest forest fire in the state’s history. | Courtesy of Planet The satellite data of Spire Global, which describes itself as a “space-to-cloud data and analytics company,” boosted the accuracy of climate models and predicted a wildfire south of Lake Tahoe in Northern California 45 days before the inferno. It also forecast where winds would drive the flames. New satellites and sensors are also being used to track human activity that might be taking advantage of environmental calamity. One example is in the Arctic, where melting ice has led to a steady rise in commercial and military activity, particularly in the summer months. “It's really opened up that whole region,” said Adam Bennett, a senior director at HawkEye 360, which operates satellites that can detect radio frequency signals. “People don’t always know what's happening up there. So we did some sweeps and it was interesting to see here how we detected all kinds of additional RF activity in some cases in places we never would have expected.” “We were detecting things even all over the sea ice,” he added. “You know different concentrations of VHF communication. We saw a lot of additional maritime activity. You could even see vessels taking these pathways around the sea ice. You would not even know they were there.” Detections can also be made in real-time when responding to major disasters. Satellites from Maxar, NOAA and the Bureau of Ocean Energy Management were used to map the early October oil spill off California’s Pacific coast. A containment boom blocks oil-contaminated water. In an aerial view, a containment boom blocks oil-contaminated water in the area of the Talbert Marsh wetlands after a 126,000-gallon oil spill from an offshore oil platform on Oct. 4 in Huntington Beach, California. | Mario Tama/Getty Images Unleashing the potential There are, of course, limitations to space-based technology, most notably in ocean environments. Satellites can capture sea surface temperatures and measure coral reefs — and they can even gauge the thickness of the oil on the surface of the water to direct cleanup crews after a spill. But they can only see a few meters deep. According to NOAA’s National Ocean Service, more than 80 percent of the world’s oceans remain unmapped, unobserved and unexplored. “That's why we need to rely on ocean technologies and ocean exploration, and a lot of the marine sensor technologies that are coming online, to understand what's going on in the deeper ocean, both in terms of biodiversity, as well as energy changes,” Morris said. Yet, the game-changing potential of satellite data can make a huge difference if it is matched with the capacity on the ground to analyze, share and apply it. And large swaths of the globe where the effects of climate change are most pronounced are not connected. In West Africa, for example, “people don't know when the big flood is coming because there's no one to really take the satellite data and make it applicable on the ground,” said Gregory Jenkins, a professor of atmospheric science and African studies at Pennsylvania State University, noting that satellite data hasn’t even been fully integrated into weather forecasting on most of the continent. “We need to do much more in terms of assimilating satellite data into the weather forecast to improve them,” Jenkins said. “But we also need ground information to evaluate whatever the forecasts or the satellites are saying.” Finding more ways to share the data needs to be the priority of global leaders, numerous experts and executives say. Jasmine Sanders, a climate scientist and marine biologist who is executive director of climate youth advocacy organization Our Climate, said there remains too wide a gap between satellite companies and the advocacy groups, the scientific community and the government agencies who can make the most of it. “There's no one in between or no entity or organization that is showing how these groups could be connected,” she said. An oil spill is pictured. Multiple satellite images were used to assess the 2020 oil spill off the coast of Mauritania after the MV Wakashio, a Japanese oil tanker, went aground. | Courtesy of Planet Bureaucratic stumbling blocks in industrialized nations like the United States are also stymying efforts to share more climate data gleaned from satellites across government agencies, said Mark Mozena, senior director of government affairs at Planet. “Getting data should not be an issue when you're dealing with an emergency like a hurricane,” he said. “It should not be an issue when you're trying to prepare for next year's fires.” Johnson said one of her priorities is “how to ensure open public access for any commercially provided data by our federal science agencies.” But ultimately applying all this new, increasingly more detailed data is about far more than just diagnosing the extent of climate change and singling out the leading causes. “It's not just about naming and shaming,” said Zolli. “It's about creating the feedback loop so that we know whether we're making progress or not.”

\

#### 2] Collision with a military satellite risks miscalculation under use it or lose it pressure – that causes global nuclear war

Egeli 21, Sitki Egeli is an assistant professor in the Political Science and International Relations Department of Izmir University of Economics. He was previously a director for foreign affairs in Turkey’s Undersecretariat for Defense Industries (SSM) and vice president in charge of the defense and aerospace sectors of an international consulting firm. “Space-to-Space Warfare and Proximity Operations: The Impact on Nuclear Command, Control, and Communications and Strategic Stability”, Journal for Peace and Nuclear Disarmament, Volume 4, 2021 - Issue 1, Pages 116-140 | Received 03 Dec 2019, Accepted 07 Jun 2021, Published online: 25 Jun 2021, <https://www.tandfonline.com/doi/full/10.1080/25751654.2021.1942681>, accessed 12/5/21, sb

Scenario 1: What’s Wrong with Our Satellite? Amid increased tensions, perhaps even an imminent military confrontation between two nuclear-armed adversaries, a high-value (for example, early-warning or strategic communication) satellite stops functioning or communicating instantly and inexplicably. SSA sensors do not pick up any anomalies. This may be the outcome of a technical malfunction or a natural phenomenon, such as the impact of a collision with a meteoroid or piece of space debris small enough to have evaded detection. Alternatively, the satellite perhaps becomes the victim of a deliberate, undetected attack. Earth-to-space kinetic, electronic, or directed energy attacks would leave behind some trails. A cyberattack, which is harder to detect and attribute, is a strong possibility. So is a stealthy attack by hostile spacecraft. In fact, the adversary is known to have experimented with ominous small spacecraft that could easily conceal or disguise themselves until conducting a final maneuver to neutralize their targets. The victim would also be aware that, especially at distant GEO and HEO altitudes, SSA is not sufficiently comprehensive to detect and give warning of all suspicious or threatening movements as they happen. As suspicions abound, decision makers are faced with hard choices. Could this perhaps be the harbinger of a wider nuclear or nonnuclear first strike, along with which the attacker is seeking to eliminate the possibility of retaliation by degrading the defender’s capacity to command, control, and communicate with its forces? Should the defender react immediately before the remaining space-enabled NC3 elements are also compromised and its control over nuclear and nonnuclear forces degrades even further? In the absence of a clear-cut picture of what actually has happened, there is a risk that impending decisions will be made on the basis of insufficient and potentially erroneous information, and the climate will be ripe for unfounded presumptions and predispositions. The resulting ultimatums, responses, or counteractions could set off a dangerous cycle of escalation and tit-for-tat actions, whereby reactions and overreactions between adversaries lead to potentially catastrophic consequences. At a minimum, heightened tension in orbit would have the outcome of spilling down to Earth so as to further aggravate an already tense situation.

#### Space conflicts are uniquely likely to go nuclear.

Grego 15 [LAURA GREGO is a physicist in the Global Security program at UCS. She is an expert in space weapons and security; ballistic missile proliferation; and ballistic missile defense. "Preventing Space War." https://allthingsnuclear.org/lgrego/preventing-space-war]

So says a very good New York Times editorial “Preventing a Space War” this week. Sounds right, if X-Wing fighters come to mind when you think space conflict. But in reality conflict in space is both more likely than one would think and less likely to be so photogenic. Space as a locus of conflict The Pentagon has known that space could be a flash point at least since the late 1990s when it began including satellites and space weapons in earnest as part of its wargames. The early games revealed some surprises. For example, attacking an adversary’s ground-based anti-satellite weapons before they were used could be the “trip wire” that starts a war: in the one of the first war games, an attack on an enemy’s ground-based lasers was meant to defuse a potential conflict and protect space assets, but instead was interpreted as an act of war and initiated hostilities. The games also revealed that disrupting space-based communication and information flow or “blinding” could rapidly escalate a war, eventually leading to nuclear weapon exchange. The war games have continued over the years with increased sophistication, but continue to find that conflicts can rapidly escalate and become global when space weapons are involved, and that even minor opponents can create big problems. The report back from the 2012 game, which included NATO partners, said these insights have become “virtually axiomatic.” Participants in the most recent Schriever war games found that when space weapons were introduced in a regional crisis, it escalated quickly and was difficult to stop from spreading. The compressed timelines, the global as well as dual-use nature of space assets, the difficulty of attribution and seeing what is happening, and the inherent vulnerability of satellites all contribute to this problem. Satellite vulnerability & solutions Satellites are valuable but, at least on an individual basis, physically vulnerable. Vulnerable in that they are relatively fragile, as launch mass is at a premium and so protective armor is too expensive, and a large number of low-earth-orbiting satellites are no farther from the earth’s surface than the distance from Boston to Washington, DC.

#### Thus, I urge you to vote for the affirmative.

# NC

#### I negate the Resolved: The appropriation of outer space by private entities is unjust

## Contention 1: Asteroid Mining

#### Commercial asteroid mining is coming now – lower costs and improving tech make it economically viable – and the legal basis is already in place in multiple countries– that helps acquire water for rocket fuel and rare earth metals

Gilbert 21 alex gilbert, is a complex systems researcher and a PhD student in space resources at the Colorado School of Mines. "Mining in Space Is Coming." Milken Institute Review, April 26, 2021, [www.milkenreview.org/articles/mining-in-space-is-coming](http://www.milkenreview.org/articles/mining-in-space-is-coming). [Quality Control]

Space exploration is back. after decades of disappointment, a combination of better technology, falling costs and a rush of competitive energy from the private sector has put space travel front and center. indeed, many analysts (even some with their feet on the ground) believe that commercial developments in the space industry may be on the cusp of starting the largest resource rush in history: mining on the Moon, Mars and asteroids.

While this may sound fantastical, some baby steps toward the goal have already been taken. Last year, NASA awarded contracts to four companies to extract small amounts of lunar regolith by 2024, effectively beginning the era of commercial space mining. Whether this proves to be the dawn of a gigantic adjunct to mining on earth — and more immediately, a key to unlocking cost-effective space travel — will turn on the answers to a host of questions ranging from what resources can be efficiently.

As every fan of science fiction knows, the resources of the solar system appear virtually unlimited compared to those on Earth. There are whole other planets, dozens of moons, thousands of massive asteroids and millions of small ones that doubtless contain humungous quantities of materials that are scarce and very valuable (back on Earth). Visionaries including Jeff Bezos imagine heavy industry moving to space and Earth becoming a residential area. However, as entrepreneurs look to harness the riches beyond the atmosphere, access to space resources remains tangled in the realities of economics and governance.

Start with the fact that space belongs to no country, complicating traditional methods of resource allocation, property rights and trade. With limited demand for materials in space itself and the need for huge amounts of energy to return materials to Earth, creating a viable industry will turn on major advances in technology, finance and business models.

That said, there’s no grass growing under potential pioneers’ feet. Potential economic, scientific and even security benefits underlie an emerging geopolitical competition to pursue space mining. The United States is rapidly emerging as a front-runner, in part due to its ambitious Artemis Program to lead a multinational consortium back to the Moon. But it is also a leader in creating a legal infrastructure for mineral exploitation. The United States has adopted the world’s first spaceresources law, recognizing the property rights of private companies and individuals to materials gathered in space.

However, the United States is hardly alone. Luxembourg and the United Arab Emirates (you read those right) are racing to codify space-resources laws of their own, hoping to attract investment to their entrepot nations with business-friendly legal frameworks. China reportedly views space-resource development as a national priority, part of a strategy to challenge U.S. economic and security primacy in space. Meanwhile, Russia, Japan, India and the European Space Agency all harbor space-mining ambitions of their own. Governing these emerging interests is an outdated treaty framework from the Cold War. Sooner rather than later, we’ll need new agreements to facilitate private investment and ensure international cooperation.

What’s Out There

Back up for a moment. For the record, space is already being heavily exploited, because space resources include non-material assets such as orbital locations and abundant sunlight that enable satellites to provide services to Earth. Indeed, satellite-based telecommunications and global positioning systems have become indispensable infrastructure underpinning the modern economy. Mining space for materials, of course, is another matter.

In the past several decades, planetary science has confirmed what has long been suspected: celestial bodies are potential sources for dozens of natural materials that, in the right time and place, are incredibly valuable. Of these, water may be the most attractive in the near-term, because — with assistance from solar energy or nuclear fission — H2O can be split into hydrogen and oxygen to make rocket propellant, facilitating in-space refueling. So-called “rare earth” metals are also potential targets of asteroid miners intending to service Earth markets. Consisting of 17 elements, including lanthanum, neodymium, and yttrium, these critical materials (most of which are today mined in China at great environmental cost) are required for electronics. And they loom as bottlenecks in making the transition from fossil fuels to renewables backed up by battery storage.

#### However, the legal framework that strikes the best balance of providing economic incentives for mining while preventing unbeneficial land claims requires a doctrine of appropriation – the plan prevents that

Meyers 15 Meyers, Ross. J.D. candidate at the University of Oregon Law School. "The doctrine of appropriation and asteroid mining: incentivizing the private exploration and development of outer space." Or. Rev. Int'l L. 17 (2015): 183. Italics in original. [Quality Control]

The doctrine of appropriation is a reasonable rule for adjudicating asteroid claims, and it could easily be modified to apply to asteroid mining. In the context of water rights, the doctrine of appropriation requires that the claimant be a landowner in order to claim the right to use a water source. It does not make sense, however, for the international community to grant complete ownership over asteroids toa single entity, so the landowner requirement of the rule should be removed. A similar modification would need to be made to the "beneficial use" language of the doctrine.

In the context of water rights, an appropriator obtains rights only to water that he or she can reasonably put to beneficial use. The metals contained in asteroids have a high level of marketability. For that reason, a mining entity could potentially put any amount of obtained metal to beneficial use, in the sense that the resources can be sold. This, however, would defeat the purpose of the rule, which is to limit such unreasonable claims. To ameliorate this problem, the doctrine of appropriation could be modified to define "beneficial use "constructively by providing that beneficial use is assumed for any resources that have been removed from the asteroid that the mining entity can reasonably hope to transport to market in a return journey. With the astronomical cost of undertaking a trip to such an asteroid, this modification would limit mining entities to only what they can carry back, thereby leaving the untapped resources available to other entities capable of making the same trip. Considering the size and profitability of metal deposits on asteroids, this modification to the doctrine of appropriation would not be overly burdensome to corporate interests. At the same time, it would satisfy the economic imperative of promoting the rapid development of asteroid resources.

By changing the landowner requirement, and qualifying the “beneficial use" language, the doctrine of appropriation would be essentially ready for application to asteroid mining claims. The only other changes necessary would be some additional requirements that are common to other space related provisions, like those found in the Outer Space Treaty of 1968. For example, a reporting requirement or clause guaranteeing asylum for other astronauts. A functional rule might read something like this:

*State parties or private entities may, upon actual possession, lay claim to natural resources found on or below the surface of asteroids. Rights to appropriate are given in order of seniority, starting with the first party to land on the surface of the asteroid and establish control over the resources, be it water, methane, metal, or any other beneficial substances. A party will be said to have established control over a resource once he has mined the substance and removed it from the asteroid. A senior appropriator may use as much of the asteroid's resources as he can take from the asteroid and put to beneficial use, and may continue to enlarge his share until another junior appropriator begins to appropriate resources from source for beneficial use. For the purposes of this Agreement, "beneficial use “refers to the amount of resources that an appropriator has removed from the asteroid that the actor may reasonably hope to bring home in a return voyage. Resources in excess of what an appropriator can reasonably hope to transport to market in a single voyage do not qualify as having a beneficial use, and are therefore not yet claimed. This means that the extraction of metal from an asteroid does not serve to provide ownership if the appropriator plans on letting the resources languish until another voyage is undertaken to secure the resources and bring them back to Earth. Junior appropriators receive rights in the source of resources (the asteroid) as they find it, and may prevent the senior appropriator from enlarging his share to the junior appropriator’s detriment under a no-injury rule. No state party will attempt to hinder other parties from landing on or using the asteroid, and parties will assist other entities on an asteroid, should they need emergency assistance. Mining claims on asteroids will be reported to the Secretary-General of the United Nations, and state parties agree to release the location of the asteroid, and any scientific findings to the United Nations, the general public, and the scientific community. In the event that the asteroid is on a collision course with any other celestial body, all state parties agree to follow the course of action suggested by the United Nations. Should the United Nations decide the asteroid must be destroyed, no state party may claim liability for resources contained within the asteroid, but not yet captured. This provision applies only to asteroids as classified by the scientific community, and does not apply to planets, comets, meteorites, or any other celestial body not mentioned.*

There is no doubt that asteroids may be extremely beneficial to mankind, both as a source of resources and as a jumping-off point to far off locations in space. The human-race has progressed scientifically and technologically to the point that space travel is within commercial reach, and the need for new international laws governing the ownership of space has never been more apparent. The Outer Space Treaty of 1968made great strides in developing rational rules for space and many of its provisions should be maintained in their original form. However, by allowing ownership of asteroids under the doctrine of appropriation, the international community can incentivize the exploration and development of space in a way that reflects the needs of society in general, without vesting an absolute monopoly in a single entity. The doctrine of appropriation helped drive American westward expansion, and its application to space mining would help drive the human race in its expansion into the space, the final frontier.

#### Asteroid mining offsets terrestrial growth that ruins the environment and enables solar power satellites – both solve climate change

Taylor 19 Chris Taylor is a veteran journalist. Previously senior news writer for Time.com a year later. In 2000, he was named San Francisco bureau chief for Time magazine. He has served as senior editor for Business 2.0, West Coast editor for Fortune Small Business and West Coast web editor for Fast Company. Chris is a graduate of Merton College, Oxford and the Columbia University Graduate School of Journalism. "How asteroid mining will save the Earth — and mint trillionaires." Mashable, 2019, mashable.com/feature/asteroid-mining-space-economy. [Quality Control]

The mission is essential, Joyce declares, to save Earth from its major problems. First of all, the fictional billionaire wheels in a fictional Nobel economist to demonstrate the actual truth that the entire global economy is sitting on a mountain of debt. It has to keep growing or it will implode, so we might as well take the majority of the industrial growth off-world where it can’t do any more harm to the biosphere.

Secondly, there’s the climate change fix. Suarez sees asteroid mining as the only way we’re going to build solar power satellites. Which, as you probably know, is a form of uninterrupted solar power collection that is theoretically more effective, inch for inch, than any solar panels on Earth at high noon, but operating 24/7. (In space, basically, it’s always double high noon).

The power collected is beamed back to large receptors on Earth with large, low-power microwaves, which researchers think will be harmless enough to let humans and animals pass through the beam. A space solar power array like the one China is said to be working on could reliably supply 2,000 gigawatts — or over 1,000 times more power than the largest solar farm currently in existence.

“We're looking at a 20-year window to completely replace human civilization's power infrastructure,” Suarez told me, citing the report of the Intergovernmental Panel on Climate Change on the coming catastrophe. Solar satellite technology “has existed since the 1970s. What we were missing is millions of tons of construction materials in orbit. Asteroid mining can place it there.”

The Earth-centric early 21st century can’t really wrap its brain around this, but the idea is not to bring all that building material and precious metals down into our gravity well. Far better to create a whole new commodities exchange in space. You mine the useful stuff of asteroids both near to Earth and far, thousands of them taking less energy to reach than the moon. That’s something else we’re still grasping, how relatively easy it is to ship stuff in zero-G environments.

#### Space mining is key to sustain global resources -- otherwise, resource wars.

MacWhorter 16 [Kevin; J.D. Candidate, William & Mary Law School, "Sustainable Mining: Incentivizing Asteroid Mining in the Name of Environmentalism", William & Mary Environmental Law and Policy Review, Vol 40, Issue 2, Article 11, <https://scholarship.law.wm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1653&context=wmelpr>] brett

A. Rare Element Mining on Earth

In the next sixty years, scientists predict that certain elements crucial to modern industry such as platinum, zinc, copper, phosphorous, lead, gold, and indium could be exhausted on Earth. 12 Many of these have no synthetic alternative, unlike chemical elements such as oil or diamonds.13 Liquid-crystal display (LCD) televisions, cellphones, and laptops are among the various consumer technologies that use precious metals.14Further, green technologies including wind turbines, solar panels, and catalytic converters require these rare elements. 15 As demand rises for both types of technologies, and as reserves of rare metals fall, prices skyrocket.16 Demand for nonrenewable resources creates conflict, and consumerism in rich countries results in harsh labor treatment for poorer countries.17

In general, the mining industry is extremely destructive to Earth’s environment.18 In fact, depending on the method employed, mining can destroy entire ecosystems by polluting water sources and contributing to deforestation.19 It is by its nature an unsustainable practice, because it involves the extraction of a finite and non-renewable resource.20 Moreover, by extracting tiny amounts of metals from relatively large quantities of ore, the mining industry contributes the largest portion of solid wastes in the world.21 The Environmental Protection Agency (EPA) describes the industry as the source of more toxic and hazardous waste than any other industrial sector [in the United States], costing billions of dollars to address the public health and environmental threats to communities. 22 Poor regulations and oxymoronic corporate definitions of sustainability, however, make it unclear as to just how much waste the industry actually produces.23

Platinum provides an excellent case study of the issue, because it is an extremely rare and expensive metal—an ore expected to exist in vast quantities in asteroids.24 Further, production of platinum has increased sharply in the past sixty years in order to keep up with growing demand for use in new technologies.25 In fact, despite their high costs, platinum group metals are so useful that [one] of [four] industrial goods on Earth require them in production. 26 Scholars do not expect demand to slow any time soon.27 Among other technologies, industries use platinum in products such as catalytic converters, jewelry production, various catalysts for chemical processing, and hydrogen fuel cells.28 While there is no consensus on how far the Earth’s reserves of platinum will take humanity, many scientists agree that platinum ore reserves will deplete in a relatively short amount of time.29

With the rate of mining at an all-time high,30 it is increasingly clear that historical patterns of mineral resources and development cannot simply be assumed to continue unaltered into the future. 31 The platinum mining industry, however, has a strong incentive to increase its rate of extraction as profits grow with the rate of demand. Without any alternative, this destructive practice will continue into the future.32

So-called platinum-group metal (PGM) ores are mined through underground or open cut techniques.33 Due to these practices, all but a very small fraction of the mined platinum ore is disposed of as solid waste.34 The environmental consequences of platinum production are thus quite significant, but like the mining industry in general, the amount of waste is typically under-reported.35

While this is due to high production levels at the moment, those levels will only increase given the estimated future demand of platinum.36 In spite of the negative consequences, mining continues unabated because it is economically important to many areas.37 The future environmental costs provide a major challenge in creating a sustainable system. Relegating at least some mining companies to near-Earth asteroids would reduce the negative effects of future mining levels on Earth. The economic benefits of mining need not be sacrificed for the sake of the environment.38

## The Case Page

#### Look to the impacts of the 1AC through a lens of improbability—

#### 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.

#### Low risk of collisions – it’s overhyped

Albrecht 16 [Mark Albrecht, chairman of the board of USSpace LLC, head of the White House National Space Council from 1989 to 1992, and Paul Graziani, CEO and founder of Analytical Graphics, a company that develops software and provides mission assurance through the Commercial Space Operations Center (ComSpOC), Congested space is a serious problem solved by hard work, not hysteria, 2016, https://spacenews.com/op-ed-congested-space-is-a-serious-problem-solved-by-hard-work-not-hysteria/]

Popular culture has embraced the risks of collisions in space in films like Gravity. Some participants have dramatized the issue by producing graphics of Earth and its satellites, which make our planet look like a fuzzy marble, almost obscured by a dense cloud of white pellets meant to conceptualize space congestion. Unfortunately, for the sake of a good visual, satellites are depicted as if they were hundreds of miles wide, like the state of Pennsylvania (for the record, there are no space objects the size of Pennsylvania in orbit). Unfortunately, this is the rule, not the exception, and almost all of these articles, movies, graphics, and simulations are exaggerated and misleading. Space debris and collision risk is real, but it certainly is not a crisis. So what are the facts? On the positive side, space is empty and it is vast. At the altitude of the International Space Station, one half a degree of Earth longitude is almost 40 miles long. That same one half a degree at geostationary orbit, some 22,000 miles up is over 230 miles long. Generally, we don’t intentionally put satellites closer together than one-half degree. That means at geostationary orbit, they are no closer than 11 times as far as the eye can see on flat ground or on the sea: That’s the horizon over the horizon 10 times over. In addition, other than minute forces like solar winds and sparse bits of atmosphere that still exist 500 miles up, nothing gets in the way of orbiting objects and they behave quite predictably. The location of the smallest spacecraft can be predicated within a 1,000 feet, 24 hours in advance. Since we first started placing objects into space there have been 11 known low Earth orbit collisions, and three known collisions at geostationary orbit. Think of it: 135 space shuttle flights, all of the Apollo, Gemini and Mercury flights, hundreds of telecommunications satellites, 1,300 functioning satellites on orbit today, half a million total objects in space larger than a marble, and fewer than 15 known collisions. Why do people worry?

#### Kessler revised predictions – it would be a century long process

Kurt 15 [Joseph Kurt, JD- William & Mary School of Law, BA-Marquette University, NOTE: TRIUMPH OF THE SPACE COMMONS: ADDRESSING THE IMPENDING SPACE DEBRIS CRISIS WITHOUT AN INTERNATIONAL TREATY, 40 Wm. & Mary Envtl. L. & Pol'y Rev. 305 (2015)]

A. Practical Considerations: Feasible Solutions to the Space Debris Problem Are on Their Way

One key question in assessing whether an international treaty is a requisite for solving the space debris problem is just how difficult it will be to fashion a remedy. The more complex and costly are feasible solutions, the more likely it is that a comprehensive regime is necessary to bind the various actors together. 93Link to the text of the note

A good place to begin is to determine just how imminent is the onset of the cascade of exponentially more frequent debris-creating collisions, known as the Kessler Syndrome. 94Link to the text of the note To be certain, no one can be sure--this phenomenon being subject to highly complex probabilities. 95Link to the text of the note Indeed, experts' estimates of when such a cascade will become irreversible vary [\*316] widely. 96Link to the text of the note The National Research Council produced a report in 2011 that suggested that "space might be just 10 or 20 years away from severe problems." 97Link to the text of the note In fact, the cascading effect has already begun, albeit at a modest pace. 98Link to the text of the note However, Donald Kessler, who first described the eponymous effect in 1978, has significantly recalibrated his own outlook over the years. 99Link to the text of the note Originally, Kessler predicted that catastrophe would result by the year 2000. 100Link to the text of the note That date long passed, Kessler now speaks of a century-long process that "we have time to deal with." 101Link to the text of the note

#### That means their arguments can’t apply, tech, International Relations, the threat of climate change will all be fundamentally changed

#### On the Impacts—

#### A] We turn sats, the electronics in sattelites require Rare Earth Minerals which are “shocker” rare, and we need to mine asteroids to sustain their supply

#### B] We fundamentally change the climate issue; it no longer needs to be monitored because mining in space stops climate change completely c/a taylor 19

#### C] resource wars are more likely to happen then their miscalc scenario—it relies on every single military satellite getting hit at once, but ours is just about states going to war because they don’t have enough water lol

# 1AR

#### Commercial space activity is coming now -- that spikes debris in outer space drastically triggering the Kessler syndrome which not only causes collisions with other satellites such as military space assets and satellites important for fighting climate change, but cuts off access to space in the first place.

#### The neg’s Fange evidence is wrong -- its looking at the status quo of debris in orbit, when we’re talking about how much more there will be in the near future. AND their ev says there are low amount of satellites, but Starlink is set to launch 12,000 satellites now, and 100,000 in the near future.

#### Their Albercht evidence is also wrong -- the only warrant is that space is big and there aren’t many satellites but 1] Low earth orbit isn’t big and will get clustered and 2] more satellites are coming.

#### Their Kurt evidence has no warrant, it literally references Kesslers work in 1978 over 40 years ago, obviously Starlink uniqueness overwhelms this evidence.

#### On their impact responses

#### 1] yes satellites require rare earth metals but a] their already there so neg doesn’t solve and b] launching more and more will be more costly to earth which decks asteroid mining’s ability to solve for their impacts, since rare earth metals need to be mined in order for us to mine them in space.

#### 2] Reject Taylor evidence -- it doesn’t say that we no longer need any info on weather to fight climate change (???).

#### 3] Miscalc can happen without every satellite getting hit, and Kessler syndrome effects ALL satellites in low earth orbit according to our evidence. outweighs their case

#### A] Magnitude -- Even IF its low probability since its an extinction level impact that mathematically outweighs, even a 1% RISK OF EXTINCTION is worse than water wars.

#### B] Timeframe -- water wars are still decades away, while megaconstellations and debris are coming now.

#### On the neg case:

#### First, Kessler Syndrome is a side-constraint on mining -- debris cuts off access to outer space which makes it impossible to mine asteroids in the first place.

#### Outweighs on timeframe, satellites that cluster orbits are coming now while asteroid mining would take years.

#### Don’t let them spin their next speech to make it seem like asteroid mining solves climate change -- we have half a decade to solve climate change and mining won’t start for at least another 10 years. And even if it does, it won’t be enough to solve for all of climate change. Satellites are key to solving climate change right now. Independently, their Taylor evidence is bad, it looks to a 20 year window.

#### Mining fails

#### 1] It’s scientifically impossible

David Fickling 12/21/2020 (“We’re Never Going to Mine the Asteroid Belt”; Bloomberg; <https://www.bloomberg.com/opinion/articles/2020-12-21/space-mining-on-asteroids-is-never-going-to-happen>)

It’s wonderful that people are shooting for the stars — but those who declined to fund the expansive plans of the nascent space mining industry were right about the fundamentals. Space mining won’t get off the ground in any foreseeable future — and you only have to look at the history of civilization to see why. One factor rules out most space mining at the outset: gravity. On one hand, it guarantees that most of the solar system’s best mineral resources are to be found under our feet. Earth is the largest rocky planet orbiting the sun. As a result, the cornucopia of minerals the globe attracted as it coalesced is as rich as will be found this side of Alpha Centauri. Gravity poses a more technical problem, too. Escaping Earth’s gravitational field makes transporting the volumes of material needed in a mining operation hugely expensive. On Falcon Heavy, the large rocket being developed by Elon Musk’s SpaceX, transporting a payload to the orbit of Mars comes to as little as [$5,357 per kilogram](https://www.spacex.com/media/Capabilities&Services.pdf) — a drastic reduction in normal launch costs. Still, at those prices just lofting a single half-ton drilling rig to the asteroid belt would use up the annual exploration budget of a small mining company. Power is another issue. The international space station, with 35,000 square feet of solar arrays, generates up to 120 kilowatts of electricity. That drill would need a similar-sized power plant — and most mining companies operate multiple rigs at a time. Power demands rise drastically once you move from exploration drilling to mining and processing. Bringing material back to Earth would raise the costs even more. Japan’s Hayabusa satellite spent six years and 16.4 billion yen ($157 million) recovering a single gram of material from the asteroid Ryugu and returning it to Earth earlier this month. What might you want to mine from space? Water is an essential component of most earth-bound mining operations and a potential raw material for hydrogen-oxygen fuel that could be used in space. The [discovery in October of ice molecules](https://www.nasa.gov/press-release/nasa-s-sofia-discovers-water-on-sunlit-surface-of-moon/) in craters on the Moon was taken as a major breakthrough. Still, the concentrations of 100 to 412 parts per million are extraordinarily low by terrestrial standards. Copper, which typically costs about $4,500 per metric ton to refine, has an average ore grade of about 6,000 ppm. The more promising commodities are platinum, palladium, gold and a handful of rare related metals. Because of their affinity for iron, these so-called siderophile elements mostly sunk toward the metallic core of our planet early in its formation, and are relatively scarce in the Earth’s crust. Estimates of their abundance on some asteroids, such as [the enigmatic Psyche 16](https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/16-psyche/in-depth/) beyond the orbit of Mars, suggest concentrations several times higher than can be found in terrestrial mines. Still, human ingenuity is all about cutting our coat according to our cloth. If such platinum-group metals are going to justify the literally astronomical costs of space mining, they’ll need to count on sustained high prices for the decade or so that would be needed to get such an operation up and running — and that sort of situation is all but unheard-of in the materials industry. When prices of an essential commodity get excessively high, chemists get extraordinarily good at finding ways to avoid using it, scrap merchants improve their recycling rates, and miners discover new deposits that wouldn’t have been viable at lower prices. Even [criminals get in on the game](https://www.bbc.com/news/business-49767195). That eventually pushes supply up and demand down, so that prices rebalance — a dynamic we’ve seen play out in the markets for rare earths, lithium and cobalt in recent years. The world mines about [three times more platinum](https://www.bloomberg.com/opinion/articles/2017-09-26/platinum-s-lesson-for-lithium-ion-batteries?sref=5JzLFdzD) than it did in the early 1970s, but prices have barely changed once adjusted for inflation. That might sound a disappointing prospect to those looking for excuses for humanity to colonize space — but really it should be seen as a tribute to our ingenuity. Humanity’s failure to exploit extraterrestrial ore reserves isn’t a sign that we lack imagination. If anything, it’s a sign of the adaptive genius that put us in orbit in the first place.

#### 2] It increases collisions and debris.

Sarah Scoles 5/27/15 (“Dust from asteroid mining spells danger for satellites”; NewScientist; https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/)

IF THE gold mine is too far from home, why not move it nearby? It sounds like a fantasy, but would-be miners are already dreaming up ways to drag resource-rich space rocks closer to home. Trouble is, that could threaten the web of satellites around Earth. Asteroids are not only stepping stones for cosmic colonisation, but may contain metals like gold, platinum, iron and titanium, plus life-sustaining hydrogen and oxygen, and rocket-fuelling ammonia. Space age forty-niners can either try to work an asteroid where it is, or tug it into a more convenient orbit. NASA chose the second option for its Asteroid Redirect Mission, which aims to pluck a boulder from an asteroid’s surface and relocate it to a stable orbit around the moon. But an asteroid’s gravity is so weak that it’s not hard for surface particles to escape into space. Now a new model warns that debris shed by such transplanted rocks could intrude where many defence and communication satellites live – in geosynchronous orbit. According to Casey Handmer of the California Institute of Technology in Pasadena and Javier Roa of the Technical University of Madrid in Spain, 5 per cent of the escaped debris will end up in regions traversed by satellites. Over 10 years, it would cross geosynchronous orbit 63 times on average. A satellite in the wrong spot at the wrong time will suffer a damaging high-speed collision with that dust. The study also looks at the “catastrophic disruption” of an asteroid 5 metres across or bigger. Its total break-up into a pile of rubble would increase the risk to satellites by more than 30 per cent (arxiv.org/abs/1505.03800). That may not have immediate consequences. But as Earth orbits get more crowded with spent rocket stages and satellites, we will have to worry about cascades of collisions like the one depicted in the movie Gravity. Handmer and Roa want to point out the problem now so that we can find a solution before any satellites get dinged. “It is possible to quantify and manage the risk,” says Handmer. “A few basic precautions will prevent harm due to stray asteroid material.” Mike Nolan of the Arecibo Observatory in Puerto Rico agrees it’s an important issue. “They’re right to consider it,” he says, “and their first stab indicates that the answer isn’t obviously ‘don’t worry’.” However, the risk is less concerning for asteroids not in this particular lunar orbit, he says. Aspiring space miners are taking the risk seriously.

#### 3] It doesn’t solve resource wars, just shifts them to outer space, which is worse since its uniquely likely to escalate, C/A AC grego 15.

Kelvey 14 [Jon Kelvey, writer and journalist based in central Maryland. Is It Legal to Mine Asteroids?,” 10/13/14, *Slate*, https://slate.com/technology/2014/10/asteroid-mining-and-space-law-who-gets-to-profit-from-outer-space-platinum.html]

If these mining ventures are successful, the world could see billions of dollars flowing down from space to American companies. Is there a system for dealing with any conflicts that asteroid mining will likely arouse? The historical record certainly suggests the possibility of bitter, even violent disputes.

Just consider the Arctic. Impenetrable ice was once the foil for those who dreamed of a Northwest Passage, but global warming has made the oil- and natural-gas-rich Arctic seabed accessible for the first time, and there has been a rush to lay claims to territory. The United States and Canada have been making careful geological measurements in order to determine territorial boundaries. Russia has pursued a different path: In 2007, the country used a submersible to plant its flag on the seabed at the North Pole. It’s an example of how contested things can get even when there is a system of rules in place, according to Joanne Gabrynowicz, a space lawyer and editor emeritus of the Journal of Space Law at the University of Mississippi School of Law. There is a system of international governance in place for the Arctic, but she says it is being strained by the recent thaw because, “it’s so much easier to govern something when you can’t get to it.”

If emerging space technologies can be thought of as melting Arctic ice, it might be time to start discussing some basic rules before everything thaws.

#### Thus I urge you to affirm

# 2NR

## The contention

#### Extend the uniqueness evidence—private companies are going to space right now to mine, but the aff stops that because it denies the legal framework that private entities use to justify their space missions and even if they can mine they can’t bring back all of their resources under the aff’s legal framework which means they would be operating at a loss—that guts incentive for the private sector to go to space and mine, we’ll go for climate change impact, mining is key to take volatile mining off of earth where it is destroying ecosystems, its key for REM which are used in sats—our evidence outlines how the industry is bottlenecking right now—our impacts come first and outweigh, A] not matter how much we monitor climate change that doesn’t actually solve for it—voting negative is necessary to create real change towards the climate B] Probability—climate change is 100% going to happen—their miscalc scenario’s are super unlikely C] magnitude—climate change affects everyone on earth negatively while space conflict will only affect a portion of people D] timeframe—we are approaching 2 degrees now, none of the aff impacts can match—kessler affect does take a long time

#### Now on the line by line

#### AT Fickling: A] no warrant—the card just says its expensive B] the evidence is specific to public entities not private ones—IE Japan C] Cross—apply the uniqueness, the tech is coming D] we can mine the moon first—so travel isnt an issue

#### AT Scoles: A] this is only volatile mining—but private entities have reason to hedge against that because they don’t want to destroy their own sats B] if we prove Kessler unlikely this goes away

#### AT Kelvy 14: A] no warrant—rushing to get resources has never escalated, which means it’s a no risk issues B] this is just mitigatory defense and not a turn—since going to space literally gives us the resources we need to stop resource wars

#### AT climate change pre-empt: Its try or die for the neg—even if the probability isnt super high it’s the highest in the round and we gave 3 scenarios in which we solve for all of climate change—this isnt a spin, its in the 1NC—their sats evidence doesn’t have causal link, just because we can see how climate change will kill us through satellites doesn’t mean we can solve for it

#### Lastly Stopping kessler isnt a pre-requisite to mining A] your kelvy evidence concedes that collisions won’t immediately cut off space B] if Kessler is unlikely you shouldn’t vote on this C] Debris tracking solves since we can find a gap in debris to escape LEO

## The case page

#### We are just going for cascades unlikely—this is probably the least covered part of the flow, if we win this, we win no risk of case—that means they lose all offense in the round—

#### A] THE DEBATE ENDS HERE, Missed warrant in fange—all sats are going in the same direction at the same speed, if you know things about physics that means they can never collide—they’ll go for an asteroid mining spin the final speech, but their 1AC link to starlink concedes that mining contributes a super small amount of debris to LEO

#### B] The Kurt evidence is from 2015—not the date they randomly made up—and these are about kesslers(the guy who came up with the theory the aff is based off of) ideas about when the earliest we could see a cascade is, that’s 100 years, which is double the timeframe of their estimation on the climate change impact

# 2AR

#### Commercial space activity is coming NOW -- companies such as Space X and Blue Origin are seeking to appropriate outer space for a profit. Extend Kelvey 22 from my first speech, these companies are set to exponentially increase satellites in space and are responsible for the vast majority of close encounters between satellites.

#### Their defense fails -- their conceding our big response to Fange which is it’s an analysis of the status quo WITHOUT Starlink Satellites, which are set to increase by 100,000!!!

#### And none of our evidence says there’ll be a small amount of debris, massive increases in activity will cumulatively produce space junk triggering the Kessler syndrome.

#### They completely missed our critique of their Kurt evidence, yes its written in a 2015 article but about Kessler’s opinion in 1978, which was literally in the evidence.

#### Prefer our evidence since it postdates theirs and takes Starlink into account which they’re failing to address.

#### Extend the Egeli and Grego evidence which proves that debris collisions with satellites will trigger space conflict which is LIKELY to escalate to nuclear war. That causes a nuclear winter which wipes out everyone on the planet.

#### Debris collision with military satellites gets interpreted as an aggressive act of war, which leads to escalation between countries. This is likely to escalate to nuclear war.

#### Their conceding our meta-weighing between probability and magnitude -- even IF our scenario was low probability, which it’s not, the extreme danger of a nuclear war outweighs the slow burn of climate change.

#### We’re winning that private appropriation of outer space will bring the Kessler syndrome in the very near future -- that frames the entire debate, since Kessler syndrome makes space inaccessible to space mining which takes out their entire contention.

#### On their responses to Kessler syndrome, A] It doesn’t need to happen right away to gut mining solvency for climate change, B] their not winning its unlikely, and C] Debris tracking is inaccurate by over a mile!

#### Also, Kelvey doesn’t concede anything, they just discuss a scenario where debris don’t cut off space, doesn’t mean its true.

#### Independently, we’ll win that space mining doesn’t solve climate change which takes out their only offense in this round.

#### They’ve conceded space mining won’t come in time to solve climate change which is terminal defense against their case! Mining simply won’t come in time to solve.

#### And we’re winning satellites are key to fighting climate change -- they give us crucial data about the climate that is prerequisite to addressing the problem, justifying policy change to lower emissions, and make sure we can sustainable switch off fossil fuels.