# **JAN/FEB AFF**

**I affirm: The appropriation of outer space by private entities is unjust.**

## Framing

#### Private companies are exploiting the OST, this deepens the wealth gap and increases climate change rates

Samuel Stockwell 20 (Sam Stockwell is a research assistant at RAND Europe working in the area of defence, security and infrastructure. His research interests include terrorism and counter-terrorism, cybersecurity, emerging technologies in conflict environments, and space security.) 7-20-2020, "," <https://www.e-ir.info/2020/07/20/legal-black-holes-in-outer-space-the-regulation-of-private-space-companies/>

Lunar rock samples from the Apollo missions containing rare Earth resources, such as Helium-3 which produces more power and less waste than traditional nuclear reactors on Earth, have since fuelled incentives for extraterrestrial resource mining (Brearley, 2006: 44-46). This was further facilitated by suggestions that near-earth objects (NEOs) like the so-called ‘Anteros asteroid’ could comprise of over five trillion dollars’ worth of magnesium silicate and aluminium (Kramer, 2017: 131). Envisaging appropriation concerns that might arise from the future extraction of space assets by spacefaring nations, Article II of the UN OST declared that: “Outer space is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means” (UN, 1967). The emphasis on claims of national sovereignty were intimately tied to the Cold War context at the time, where space activities were under the exclusive monopoly of governmental agencies and initiated for goals of military dominance or national prestige (Sachdeva, 2017: 210). However, the privatisation of the space industry that has occurred since the 1980s has meant that the legislation leaves an enormous amount of legal ambiguity and interpretation regarding the regulation of private resource mining in space. As Shaer (2016) demonstrates, the Article II provision fails to address either the exploitation of space for financial gain or the property claims of commercial enterprises (Shaer, 2016: 47). Nevertheless, Article VI of the UN OST asserts that: “States shall be responsible for national space activities whether carried out by governmental or non-governmental entities” (UN, 1967; own emphasis). Some scholars have suggested that this clause significantly restrains the activities of private space corporations by incentivising states to regulate their domestic organisations for fear of liability concerns (Abeyratne, 1998: 168). However, the US government recently enacted a piece of legislation which exploited this clause, in order to circumvent its own restrictions and strengthen US economic influence in space. The passage of the 2015 SPACE Act enabled US citizens to privately “possess, own, transport, use, and sell the resources” they obtain in outer space, whilst making careful consideration to deny national sovereign claims over such materials (Leon, 2018: 500). Yet, regardless of whether it is an American private company or public venture, the US is still satisfying its geopolitical interests; by exclusively siphoning off extra-terrestrial resources for American gain, the nation’s soft power is thereby extended at the expense of spacefaring adversaries such as China (Basu & Kurlekar, 2016: 65). Indeed NewSpace actors cleverly played on these strategic concerns prior to the bill’s passage, with billionaire space entrepreneur Robert Bigelow asserting that the biggest danger wasn’t private enterprises on the Moon, but that “America is asleep and does nothing, while China comes along… surveying and laying claim [to the Moon]” (Klinger, 2017: 222). The US government’s support for private space companies is also likely to lead to the reinforcement of Earth-bound wealth inequalities in space. Many NewSpace actors frame their long-term ambitions in space with strong anthropogenic undertones, by offering the salvation of the human race from impending extinction through off-world colonial developments (Kearnes & Dooren: 2017: 182). Yet, this type of discourse disguises the highly exclusive nature of these missions. Whilst they seem to suggest that there is a stake for ordinary citizens in the vast space frontier, the reality is that these self-described space pioneers are a member of a narrow ‘cosmic elite’ – “founders of Amazon.com, Microsoft, Pay Pal… and a smattering of games designers and hotel magnates” (Parker, 2009: 91). E-International Relations ISSN 2053-8626 Page 2/8 Legal ‘Black Holes’ in Outer Space: The Regulation of Private Space Companies Written by Samuel Stockwell Indeed, private space enterprises have themselves suggested that they have no obligation to share mineral resources extracted in space with the global community (Klinger, 2017: 208). This is reflected in the speeches of individuals such as Nathan Ingraham, a senior editor at the tech site EngadAsteroid mining, who claimed that asteroid mining was “how [America is] going to move into space and develop the next Vegas Strip” (Shaer, 2016: 50). Such comments highlight a form of what Beery (2016) defines as ‘scalar politics’. In similar ways to the ‘scaling’ of unequal international relations that has constituted our relationship with outer space under the guise of the ‘global commons’ (Beery, 2016: 99), private companies – through their anthropogenic discourse – are scaling existing Earthbound wealth inequalities and social relations into space by siphoning off extra-terrestrial resources. By constructing their endeavours in ways that appeal to the common good, NewSpace actors are therefore concealing the reality of how commercial resource extraction serves the exclusive interests of their private shareholders at the expense of the vast majority of the global population.

#### The wealth gap is increasing, climate change is happening, millions of people will die if we don’t affirm, thus Util is the only moral system available to policymakers.

Robert E. Goodin 95 [professor of government at the University of Essex, and professor of philosophy and social and political theory at Australian National University], “Utilitarianism as a Public Philosophy”, Cambridge Studies in Philosophy and Public Policy, May 1995, BE

Consider, first, the argument from necessity. Public officials are obliged to make their choices under uncertainty, and uncertainty of a very special sort at that. All choices - public and private alike - are made under some degree of uncertainty, of course. But in the nature of things, private individuals will usually have more complete information on the peculiarities of their own circumstances and on the ramifications that alternative possible choices might have for them. Public officials, in contrast, are relatively poorly informed as to the effects that their choices will have on individuals, one by one. What they typically do know are generalities: averages and aggregates. They know what will happen most often to most people as a result of their various possible choices. But that is all. That is enough to allow public policy-makers to use the utilitarian calculus - if they want to use it at all - to choose general rules of conduct. Knowing aggregates and averages, they can proceed to calculate the utility payoffs from adopting each alternative possible general rule. But they cannot be sure what the payoff will be to any given individual or on any particular occasion. Their knowledge of gener- alities, aggregates and averages is just not sufficiently fine-grained for that.

**The standard is maximizing well being**

## 1AC: Space Congestion

#### Explosions in orbit cause debris. Clean up efforts aren’t working

Michelle Starr 20 [Michelle Starr. . “Earth's Space Debris Problem Is Getting Worse, And There's an Explosive Component”. 10-13-2020. ScienceAlert. https://www.sciencealert.com/the-space-debris-problem-is-getting-worse-not-better. Accessed 7-25-2021]

Before humans first started sending objects into Earth orbit, the pocket of space around our planet was clear and clean. But the launch of Sputnik 1 in October of 1957 changed everything. Since then, the space debris has been accumulating, with the amount of useless, defunct satellites vastly outnumbering the operational objects in our orbit. A new annual report from the European Space Agency (ESA) has found that while we have become aware of the problem and taken steps in recent years to mitigate it, those steps are currently not keeping up with the sheer scale of space junk. All spacefaring nations have contributed to the problem, which is significant: as more and more defunct objects populate near-Earth space, the risk of collision rises - which, as objects crash and shatter, produces even more space debris. The hazards have been prominent in the last year. We have not only watched as two large dead satellites very nearly collided, but the International Space Station has had to undertake emergency manoeuvres three times to avoid colliding with space debris. But collisions are not even close to being the biggest problem, according to the ESA's report. In the last 10 years, collisions were responsible for just 0.83 percent of all fragmentation events. "The biggest contributor to the current space debris problem is explosions in orbit, caused by left-over energy - fuel and batteries - onboard spacecraft and rockets," said Holger Krag, head of the ESA's Space Safety Programme. "Despite measures being in place for years to prevent this, we see no decline in the number of such events. Trends towards end-of-mission disposal are improving, but at a slow pace." fragmentation events The causes of fragmentation events over the past decade. (ESA) The space junk problem was first raised in the 1960s, but it took a long time for mitigation measures to be identified and implemented. Now, spacefaring nations are much better at planning for what happens to satellites and rockets at the end of their missions. Reusable rockets are a big one, although the technology is still in its infancy. For decades, rocket boosters were just left to drift away once they'd delivered their payloads into low-Earth orbit. Some of those discarded boosters have been out there for decades. Other mitigation measures include designing and building spacecraft that can better withstand the harsh environment of space without, 12 fragmentation events have taken place every year for the past two decades. That number is rising, with each fragmentation event potentially introducing thousands of pieces of small debris in Earth orbit. At orbital velocities, even the tiniest pieces of debris can disable an operational satellite. According to the ESA's statistical model, there are over 130 million pieces of anthropogenic space debris smaller than a millimetre. The only way we can hope to do anything about the problem is by working together.

#### There’s 8,000 Tons of Debris In Our Atmosphere

**Weiner 3/21** Weiner, Chloee. "New Effort To Clean Up Space Junk Reaches Orbit." NPR.org, 21 Mar. 2021, https://www.npr.org/2021/03/21/979815691/new-effort-to-clean-up-space-junk-prepares-to-launch. Accessed 25 Jul. 2021.

A demonstration mission to test an idea to clean up space debris launched Monday morning local time from the Baikonur Cosmodrome in Kazakhstan. Known as ELSA-d, the mission will exhibit technology that could help capture space junk, the millions of pieces of orbital debris that float above Earth. The more than 8,000 metric tons of debris threaten the loss of services we rely on for Earth-bound life, including weather forecasting, telecommunications and GPS systems. The spacecraft works by attempting to attach itself to dead satellites and pushing them toward Earth to burn up in the atmosphere. ELSA-d, which stands for End-of-Life Services by Astroscale, will be carried out by a "servicer satellite" and a "client satellite" that launched together, according to Astroscale, the Japan-based company behind the mission. Using a magnetic docking technology, the servicer will release and try to "rendezvous" with the client, which will act as a mock piece of space junk. The mission, which will be run from the U.K., will carry out this catch and release process repeatedly over the course of six months. The goal is to prove the servicer satellite's ability to track down and dock with its target in varying levels of complexity. The spacecraft is not designed to capture dead satellites already in orbit, but rather future satellites that would be launched with compatible docking plates on them. The Astroscale team performs pre-launch tests at the Baikonur Cosmodrome in February 2021. Space junk has been a growing problem for years as human-made objects such as old satellites and spacecraft parts build up in low Earth orbit until they decay, deorbit, explode or collide with other objects, fragmenting into smaller pieces of waste. In 2019, for example, India blew apart one of its satellites orbiting Earth, creating hundreds of pieces of debris that threatened to collide with the International Space Station. According to a recent report by NASA, at least 26,000 of the millions of pieces of space junk are the size of a softball. Orbiting along at 17,500 mph, they could "destroy a satellite on impact." More than 500,000 pieces are a "mission-ending threat" because of their ability to impact protective systems, fuel tanks and spacecraft cabins. And the most common debris, more than 100 million pieces, is the size of a grain of salt and could puncture a spacesuit, "amplifying the risk of catastrophic collisions to spacecraft and crew," the report said. According to NASA, cleaning up space — and addressing the risks associated with debris — depend on preventing the accumulation of more waste and actively removing it. The development of other cleanup technologies has been underway for years. In 2016, Japan's space agency sent a 700-meter tether into space to try to slow down and redirect space junk.

#### By reducing the appropriation of outer space by private entities, sustainability is introduced which solves security, debris, traffic and SSA.

Aganaba-Jeanty 16 (, T., 2016. Space Sustainability and the Freedom of Outer Space. [online] Taylor & Francis. Available at: <https://www.tandfonline.com/doi/full/10.1080/14777622.2016.1148463> [Accessed 15 December 2021] Timiebi is an assistant professor of Space and Society, in the School for the Future of Innovation in Society, an affiliate faculty with the Interplanetary Initiative, a senior global futures scientist with the Global Futures Lab, and holds a courtesy appointment at the Sandra Day O’Connor College of Law, all at Arizona State University. Timiebi was a post-doctoral fellow and is a senior fellow at the Centre for International Governance Innovation (CIGI) based in Waterloo, Ontario Canada where she focused on environmental and space governance. Timiebi was Executive Director of the World Space Week Association coordinating the global response to the UN 1999 declaration that World Space Week should be celebrated Oct 4-10 annually. She is currently on the Advisory Board for the Space Generation Advisory Council supporting the UN Programme on Space Applications. She is also on the Science Advisory Board of World View Enterprises and the SETI Institute. - pp. 10-13.)-rahulpenu---Critique of status quo polices for space sustainability---New regimes key---Sustainability needs to be in law---Perm VS Global South KsDefinitions of space sustainability The Secure World Foundation defines space sustainability as “ensuring that all humanity can continue to use outer space for peaceful purposes and socioeconomic benefit.”39 It is also described as “the ability of all humanity to continue to use outer space for peaceful purposes and socioeconomic benefit over the long term.” It is proposed that, read together, these broad definitions take as their premise that: (1) all humanity thus far is using space for peaceful purposes and for socioeconomic benefit; (2) this use is threatened; (3) measures must be taken to protect it; and (4) all humanity currently possesses the ability, in the sense of having a skill or the capacity, to ensure space sustainability for peaceful purposes. Under this conceptualization, the negative effect of not using space sustainably is primarily economic.40 Bearing in mind the governmental origins of space exploitation, where market economics did not play a primary role in decision making, the growing focus on the economic perspective in space affairs acknowledges Carolyn Deere’s opinion that problems emerge in the international domain from an absence of powerful economic interests.41 Of course, as more space applications are developed, economic interests become more prevalent in that market protectionism then underlies the rationales for many positions taken. Space sustainability is also conceptualized as defining good behavior, its boundaries, and disincentives for negative behavior in space.42 Space sustainability then becomes a much more limited political concept calling for specific measures to strengthen norms.43 Some notable examples follow: An International Code of Conduct—the European Union proposed a non-binding voluntary code whose purpose is “security, safety, sustainability” for all space activities providing for general measures on space operations and space debris.44 The Scientific and Technical Subcommittee of UNCOPUOS working group objective of establishing guidelines for the long-term sustainability of outer space activities. Proposed International Civil Aviation Organization for Space—the establishment of an international organization focused on space safety and the establishment of binding safety standards similar to the International Civil Aviation Organization.45 Industry efforts for a global space situational awareness database Group of Governmental Experts (GGE) on Transparency and Confidence Building Measures. Depending on the forum for discussion and in line with the previously mentioned initiatives, the concept of space sustainability is also used interchangeably with the following: (1) space security, which entails access to space and freedom from threats;46 (2) space stability addressing space situational awareness;47 (3) space safety, which is protection from all unreasonable levels of risk (primarily protection of humans or human activities);48 and (4) responsible uses of space.49 These all reflect the two components of space sustainability as described by the founder of Secure World Foundation: “the first is the physical environment, which includes management of space debris, electromagnetic and physical crowding and congestion, and space weather.... The second component is the political environment, and includes promoting stability and preventing conflict between nations.”50 Bearing this in mind and notwithstanding the potential confusion caused by the interchangeability of terms used, at the core of all proposals conceptualizing space sustainability or related concepts are the notions that: (1) space assets are kept safe and secure, and that the assets are not harmed or interfered with; (2) peaceful space activities continue as free from purposeful/intentional or unintentional harmful interference; (3) the space environment is preserved for peaceful uses; and (4) international cooperative efforts are required. These four points are understood to be the current core conditions for and of space sustainability. It must be acknowledged that space sustainability, in this context, is severed from the ecological roots of sustainable development. Rationale for space sustainability The proposed baseline conditions for the current conception for space sustainability coincide with Gallagher’s analysis of the logic for space cooperation as “Space Governance for Global Security” where all space actors seek “to secure the space domain for peaceful use; to protect space assets from all hazards; and to derive maximum value from space for security, economic, civil, and environmental ends.”51 Based on this understanding, the current conception of and rationale for space sustainability ties more clearly to global security than to sustainable development. This logic emphasizes that “the more different countries, companies, and individuals depend on space for a growing array of purposes, the more they need equitable rules, shared decision-making procedures, and effective compliance mechanisms to maximize the benefits that they all can gain from space, while minimizing risks from irresponsible space behaviors or deliberate interference with legitimate space activities.”52 While it is acknowledged that such a need exists, the difficulty in reaching agreement on how to bring it about is one reason why some states are more focused on producing a dialogue on long-term sustainability. This is seen in the proliferation of reports outlining best practices and options that enhance sustainability through increased information sharing, as well as a focus on technical issues rather than on the creation of any new legal regimes. To minimize some of the risks of non-sustainable space use, Weeden53 proposes a three-pillar technical approach to space sustainability: (1) debris mitigation; (2) debris removal; and (3) space traffic management. This is conjoined with an immediate need for data in support of conjunction assessment and collision avoidance. This emphasis on data sharing/collection includes enabling research into potential solutions to the problem of space debris, and enhancing transparency and cooperation among states. Weeden also suggests that this narrow approach to space sustainability serves both to educate space actors about the severity of the space debris problem and to provide stability to reduce the likelihood of conflict. A common approach to data also serves as verification for a potential code of conduct in space, setting the stage for future space governance models. These proposals follow the logic of sustainability for global security. While this logic is in line with the dominant conceptualization of benefit sharing and freedom of outer space, the position taken in this article is that it does not adequately speak to sustainability from the perspective of aspirant space states. To do so requires a significantly broader discussion and solutions aimed towards aligning space law and policy with the sustainable development paradigm, if understood as being an inclusive paradigm and not focused on the individualistic/self-interested nature of the current conception of sustainable development. A systemic, sustainable development law approach calls for a conscious engagement with the web of overlapping social, environmental, cultural, and legal frameworks, as well as cultural considerations, economic policies, expectations, players, and interests.54 Bearing in mind current U.S. space policy,55 such a broad overarching objective may not be achievable as part of the dialogue on the “Long Term Sustainability of Outer Space Activities,” but U.S. policy regarding preservation of the space environment nevertheless offers insights because international initiatives congruent with it are likely to garner the most support. Schrogl56 proposed that sustainability is rendered to threats and risks to satellite operations. This approach acknowledges the intersection of multiple issue areas: environment, security, mobility, knowledge, resources, and energy. This intersection of issue areas is more akin to the wider discourse of sustainability development of and on the Earth, and prompts a discussion of value to emerging and aspirant space actors. Otherwise, the dominant conceptualization of space sustainability removes any focus upon providing for the needs of those not among the most advanced space nations. This problem is highlighted in Peter and Rathgeber’s definition of space sustainability: Sustainable space activities can be seen as activities (in space, from space, through space and towards space) that meet the needs of the present space actors without comprising the ability of future generations to meet their own needs of performing space related operations safely.57 Peter and Rathgeber claim that the emergence of new institutional space actors, particularly from the south, is putting a greater pressure on the space environment and that the participation of the south in space sustainability efforts is unsatisfactory.58 Yet, the role of less-advanced nations in sustainability initiatives is more so on the receiving end in that advanced nations seek to engage newcomers to space during the early phase of the development of future directives and codes of conduct for sustainable space activities; that is,not really to seek their input, but to ensure compliance by the less-advanced nations.59 Their space activities are judged as either threats to or consistent with space sustainability, rather than as part of articulating the content of space sustainability.60 This indicates that, for national space programs of established space nations, a truly international focus on space sustainability is not a priority**.** It is interesting to note, at this juncture in the discussion, a fundamental provision proposed by a group of developing states during the development of the U.N. Space Benefits Declaration.61 (1) All States should pursue their activities in Outer Space with due regard to the need to preserve Outer Space, in such a way as not to hinder its continued utilization and exploration. (2) States should pay attention to all aspects related to the protection and preservation of the Outer Space environment, especially those potentially affecting the Earth’s environment. (3) States with relevant space capabilities and with programs for the utilization and exploration of outer space should share with developing countries on an equitable basis the scientific and technological knowledge necessary for the proper development of programs oriented to the more rational utilization and exploration of Outer Space.62 Paragraph 3 is fundamental and truly revealing when read in the light of the analysis of Schrogl.63 Schrogl claims that the declaration takes up the problem of space debris, which might endanger future space utilization to a significant extent. However, he also states that “the wish [of the Developing countries] to be informed about debris prevention measures voiced. . . is reasonable but actually needs no mentioning since these technological developments are discussions and documented publicly to the greatest extent.”64

#### Congestion creates rivalrous orbits.

Fabian 19 (Christopher; January 2019; B.S. from the United States Air Force Academy, thesis submitted in partial fulfillment of the requirements for a M.S. from the University of North Dakota, approved by the Faculty Advisory Committee and in coordination with Dr. Michael Dodge, David Kugler, and Brian Urlacher; University of North Dakota Scholarly Commons, “A Neoclassical Realist’s Analysis Of Sino-U.S. Space Policy,” <https://commons.und.edu/theses/2455/>)

b. Defect/Defect The ubiquity of space technology has also yielded the negative externality of overcrowding the space domain. Despite its seemingly unlimited size, there are a limited number of useful earth-centric orbits to optimize terrestrial coverage. It is projected that there are over 300,000 medium sized objects capable of causing catastrophic failure of a satellite upon collision currently in earth’s orbit.159 Of these objects, 20,000 are actively tracked by the comparatively robust space surveillance network (SSN) of the United States Air Force, only 1,000 are active payloads, and even fewer have maneuver capability.160 Recent trends indicate that the problem of orbital congestion will only worsen in the coming decades as the barriers to entry are reduced. Launch service cost is rapidly decreasing due to an increased number of service providers and technology revolutions such as reusable rockets. Also, the miniaturization and simplification of satellite payloads further reduces the cost and infrastructure needed to be a spacefairing nation.161 This is evidenced by the near doubling of state operated satellites from 27 in 2000 to over 50 in 2012, coupled with a near doubling in total space objects from 1997 to 2007.162 The accumulation of space debris is a vital concern to the sustainable development of the space environment due to the increased probability of conjunction between active payloads and all other objects that results from crowded orbits. This increase in collision probability occurs proportionally to the number of objects in a given orbital domain. The tripling of orbital debris projected to occur in the next century, due to routine use and accumulation alone, would cause a tenfold increase in the probability of collision. In the event of a catastrophic collision between two objects, the resulting debris cloud could cause a cascading effect. Each successive collision increases the probability of another occurrence in a given orbit until an instability threshold is reached. At this threshold, debris removal due to decay would be negligible compared to debris created by subsequent collisions. As the propagation of debris continues, the cost of launching a satellite would eventually outweigh the benefits received due to the probability of that asset being destroyed by errant debris, effectively rendering the given orbit unusable. This debris propagation model and the dangers associated with it are colloquially referred to as the Kessler Syndrome. Kessler asserts unstable regions of low earth orbit (LEO) currently exist and that, barring the addition of more debris, a major collision would occur once every 10-20 years. If debris doubles, as it has in the last decade, the collision rate would increase to 2.5 years. Although most models’ time scales are on the order of centuries, it is widely accepted that the current rate of debris accumulation will render critical orbits unusable unless immediate measures are taken to return stability.163 There is near universal acceptance of the danger space debris presents, yet little substantive action has been taken to solve the problem. Current debris accumulation and propagation models show that earth orbiting domains are finite resources. Continued unsustainable development moving forward may preclude future usage, making earth orbits rivalrous goods.164 Furthermore, orbital domains are made a non-excludable good by the OST which states, “Outer space… shall be free for exploration and use by all States without discrimination of any kind.”165 As a non-excludable public good, space succumbs to the tragedy of the commons where the privately beneficial strategy of space utilization differs significantly from the socially optimal strategy promoting orbital stability.166 Understandably, most analysis has focused on solving the problem of orbital instability by addressing the market failure responsible for debris creation. The current reasoning suggests that if actors creating space debris internalize the cost of their actions, a solution can arise. Proposed solutions run the gamut of ideologies from free market tax incentives, to command and control legislation, to restructuring orbital property rights. Scientific solutions have also been proposed, but technological feasibility and cost remain major problems. Furthermore, analogous environments susceptible to the tragedy of the commons have been examined in hopes that they may prove applicable to the problem of orbit instability.167 This analysis is ultimately useful if the problem is to be solved under nominal conditions, but there is an underlying problem that needs to be addressed before any of these proposed solutions can realistically be enacted.

#### That triggers missile radars.

Hoots 15 (Felix; Fall 2015; Distinguished Engineer in the System Analysis and Simulation Subdivision, Ph.D. in Mathematics from Auburn University, M.S. in Mathematics from Tennessee Tech University; Crosslink, “Keeping Track: Space Surveillance for Operational Support,” <https://aerospace.org/sites/default/files/2019-04/Crosslink%20Fall%202015%20V16N1%20.pdf>)

The launch of Sputnik on October 4, 1957, marked the beginning of the Space Age. It also marked the beginning of an intense space race that brought a remarkable rate of rocket launches. In a very short time, the number of objects in orbit grew dramatically. This created a host of strategic challenges, including the need for space surveillance. In particular, the Air Force needed a way to prevent false alarms as satellites came within view of missile-warning radars, while the Navy needed a way to alert deployed units of possible reconnaissance by satellites overhead. These needs led to the establishment of a military mission to maintain a catalog of all Earth-orbiting objects—active payloads, rocket bodies, and debris—along with detailed information about trajectory and point of origin. Such a catalog could be used to filter normal orbital passages from potential incoming missiles and predict the passage of suspected spy satellites. The first catalog was relatively small in comparison with today’s version, which lists more than 22,000 items (as of May 2015). Also, the current version supports much more than the original military mission—and Aerospace is helping to extend its utility even further. The Space Catalog The Space Catalog is maintained by the Joint Space Operations Center (JSpOC) at Vandenberg Air Force Base, part of U.S. Strategic Command. One of the missions of JSpOC is to detect, track, and identify all artificial objects in Earth orbit. A key component of this mission is the Space Surveillance Network, a worldwide system of ground-based radars along with ground-based and orbital telescopes. The radars are used primarily for tracking near-Earth satellites with orbital period of 225 minutes or less, as well as some eccentric orbits that come down to near-Earth altitudes as they go towards their perigee. Ground-based telescopes are used for tracking more distant satellites, with orbital period greater than 225 minutes, and space-based sensors are used to track both near and distant satellites. The JSpOC tasks these sensors to track specific satellites and to record data such as time, azimuth, elevation, and range. This data is used to create orbital element sets or state vectors that represent the observed position of the satellite. The observed position can then be compared with the predicted position. The dynamic models used for predicting satellite motion are not perfect; factors such as atmospheric density variation caused by unmodeled solar activity can cause the predicted position to gradually stray from the true position. The observations are used to correct the predicted trajectory so the network can continue to track the satellite. This process of using observations to correct and refine an orbit in an ongoing feedback loop is called catalog maintenance, and it continues as long as the satellite remains in orbit. Ideally, the process is automatic, with manual inter vention only required when satellites maneuver or get near to reentry due to atmospheric drag. Sometimes, however, more effort is required. For example, a sensor may encounter a satellite trajectory that does not correspond well to anything in the catalog. Such observations are known as partially correlated observations if they are somewhat close to a known orbit or uncorrelated observations (or uncorrelated tracks) if they are far from any known orbit. Also, if a satellite is not tracked for five days, it is placed on an attention list for manual intervention. In that case, an analyst will attempt to match the wayward satellite to one of these partially correlated or uncorrelated tracks. If that effort succeeds, then the element sets are updated, and the object is returned to automatic catalog maintenance. On the other hand, if the satellite cannot be matched to a partially correlated or uncorrelated track, the satellite information continues to age. If it reaches 30 days without a match, the satellite is placed on the lost list. Risk Prediction One of the most visible uses of the catalog is to warn about collision risks for active payloads. This function predicts potential close approaches three to five days in advance to allow time to plan avoidance maneuvers, if necessary. Unplanned maneuvers may disturb normal operations and deplete resources for future maneuvers, so one would like to have high confidence in the collision-risk predictions. The reliability of the predictions depends directly on the accuracy of the orbit calculation, which in turn depends on the quality and quantity of the tracking data, which is limited by the capability of the Space Surveillance Network. Simply put, there are not enough tracking resources in the network to achieve high-quality orbits for every object in the catalog. Furthermore, many smaller objects can only be tracked by the most sensitive radars, and this tracking is infrequent. Most objects in the catalog are considered debris, which can neither maneuver nor broadcast telemetry. On the other hand, some satellite operators depend exclusively on the satellite catalog to know where their satellites are, and users of the satellite orbital data depend on the catalog to know when the satellites will be within view. This situation creates a challenging problem in balancing Space Surveillance Network resources to support the collision-warning task (tracking as many potential hazards as possible) while also providing highly accurate support to operational satellites (tracking the spacecraft as precisely as possible). The practical solution is to perform collision risk assessment using a large screening radius to ensure no close approaches are missed despite lower-quality predictions. Once an object is identified as having a potentially close approach, then the tasking level is raised, with the expectation that more tracking data will be obtained to refine the collision risk calculations. When the danger has passed, the object reverts to a normal tracking level. Collisions and spontaneous breakups do happen. The first satellite breakup occurred on June 29, 1961, when residual fuel in an Ablestar rocket body exploded, creating 296 trackable pieces of debris. Since that time, there have been more than 200 satellite breakups, the most notable being the missile intercept of the Fengyun-1C satellite, which created more than 3300 trackable fragments. In most cases, these breakups are first detected by the phased-array radars in the Space Surveillance Network. When multiple objects are observed where only one was expected, the downstream sensors are alerted, but no tasking is issued because specific debris orbits are not yet established. Tracks are taken and tagged as uncorrelated. Analysts at JSpOC then attempt to link uncorrelated tracks from different sensors to form a candidate orbit. Subsequent tracking improves the orbit to the point that the object can be named and numbered and moved into the catalog for automatic maintenance.

#### Nuclear war.

Rogoway 15 (Tyler; November 12; Defense Journalist and Editor of Time Inc’s The War Zone; Jalopnik, “These Are The Doomsday Satellites That Detected The Explosion Of Metrojet 9268,” <https://foxtrotalpha.jalopnik.com/these-are-the-doomsday-satellites-that-detected-the-exp-1737434876>)

For over 50 years the Pentagon has had early warning satellites in orbit aimed at spotting launches of ballistic missiles, especially the big intercontinental kind that can fly around the globe in less than 30 minutes and bring about nuclear Armageddon. Recently, these satellites have made news for their “secondary capabilities,” spotting the downing of Metrojet Flight 9268 and Malaysian Airlines Flight 17. These are the shadowy satellites that are capable of such amazing feats, and an idea of how they work. In 1960, at the height of the Cold War and at the dawn of the space age, the first Missile Defense Alarm System (MiDAS) satellite was launched into low earth orbit. Six years later there was a constellation of nine of these satellites roaming the heavens, each scanning the Soviet Union for large infrared plumes, the tell-tale sign of a ballistic missile or rocket launch. These fairly crude, low-earth orbit satellites, along with the radar-based Ballistic Missile Early Warning System, would be the basis for a Cold War ballistic missile surveillance system that would become ever more complex and capable as the years went by. If ballistic missile launches were detected and deemed a threat, the decision to retaliate would mean the National Command Authority making the call to do so within half an hour, an act that could bring an the end of humanity’s reign on Earth, permanently. The first really reliable and full coverage space-based ballistic missile early warning capability came with the launch of the first Defense Support Program (DSP) satellite in 1970. These new satellites were much more capable than their MiDAS predecessors. Early DSP satellite design was relatively straight forward, with the satellites’ spinning around their center axis while in geosynchronous orbit. This allows their telescopic infrared sensor to continuously sweep an area of the planet in a relatively brief amount of time, around six times in one minute. If something were detected, the information would immediately be data-linked to controllers on the ground at the 460th Space Wing located at Buckley AFB in in Colorado. A total of 23 of these satellites have been launched over the program’s life, with constant upgrades made along the way. A DSP satellite was launched by the Space Shuttle on STS-44 in 1991, and the last one was launched by a Delta IV Heavy in 2007. Most famously, the Defense Support Program constellation of satellites were used to detect launches of SCUD missiles during Operation Desert Storm.

## 1AC: Colonial Climate Change

#### **Climate change kills minorities faster just so Bezos can be an astronaut**

Jeremy Williams 21 — [Jeremy Williams, “The Racial Violence of Climate Change,” Foreign Policy, 11-9-2009, https://foreignpolicy.com/2021/07/21/the-racial-violence-of-climate-change/, accessed 1-19-2022]

In September 2016, activists in Britain managed to breach the security of London City Airport and get onto the runway. There, they erected a tripod and locked themselves onto and around it. Flights were disrupted for around six hours, and 131 planes were rerouted before police could dismantle the protest. Nine arrests were made. The action was carried out by Black Lives Matter U.K. (BLM U.K.), and the banners they laid out on the ground read, “the climate crisis is a racist crisis.” The action was carried out to “highlight the U.K.’s environmental impact on the lives of Black people locally and globally,” BLM U.K. said in a statement. “Black people are the first to die, not the first to fly, in this racist climate crisis.” Beyond making the connection between climate change and the global inequality of its effects, the protesters’ choice of London City Airport is also significant because it is in the London borough of Newham. London is already the most ethnically diverse city in Britain, and Newham has the smallest percentage of white residents of any local authority in the country, at 29 percent. It is an archetypal “sacrifice zone”—a poorer district with a disproportionate number of Black and Asian residents who put up with more than their fair share of noise and pollution. London City Airport, meanwhile, serves the elite business travelers of London’s financial center. It’s a totemic example of inequality, and its plans to expand further into Newham would later make the airport a target of the climate activist group Extinction Rebellion. It was perhaps the first time climate and race were connected in the British press, although it was widely misunderstood. “Have you been hijacked?” the BBC asked a BLM U.K. spokesperson. The *Daily Mail* complained that “all of those involved were white and all from privileged backgrounds,” even though this was a deliberate decision. Even some antiracism campaigners were divided on the protest, wondering if it was a distraction from the real issues. What did flying have to do with Black Lives Matter? actions: “When we say Black Lives Matter, we mean all Black lives, and that includes the lives of those who live in proximity to airports, to power plants, to the busiest of roads, and whose children grow up with asthma and skin conditions exacerbated by air pollution.” One particular child comes to mind: Ella Kissi-Debrah. After suffering from respiratory problems for several years, she died in 2013 after a particularly severe asthma attack. She was 9 years old. Her mother, Rosamund Kissi-Debrah, knew air pollution in their area of London was a factor in her condition and therefore in her death. But as is usually the case, the official cause of death was recorded as asthma. It was only after a long legal case that an inquest ruled in 2020: “Ella died of asthma contributed to by exposure to excessive air pollution.” It was the first time a coroner in the United Kingdom had named air pollution as a cause of death. London’s Black residents face greater exposure to air pollution, and some of the city’s most polluted districts have large Black populations. There is a racial dimension to air pollution in London, another example of environmental injustice and an echo of the Black Lives Matter rallying cry “I can’t breathe.” Black Lives Matter has mainly been associated with police brutality and mass incarceration along with violence against Black people generally. But in counting the cost of climate change or air pollution, it’s important to recognize that environmental harm is also a form of violence. The most obvious form of violence is direct or interpersonal, when one person’s actions are seen to harm somebody else. But violence, like racism, can also be understood as structural, embedded in cultural and social patterns. The idea of structural violence was first developed by Johan Galtung in the 1960s. Galtung was an early practitioner of what is now called “peace studies,” a social studies discipline that deliberately distanced peacebuilding and conflict resolution from the study of conflict itself. He argued that violence can be understood at three levels. At the bottom is cultural violence—long-standing attitudes such as white supremacy or male superiority, for example. This cultural violence legitimizes structural violence, which emerges as patterns of disadvantage, such as racial or gender inequality. The third level is the acts of direct violence that reflect inequality: police shootings or acts of violence against women. Understood in this wider perspective, violence flows upward from deep roots. Violent acts flow from inequalities that, in turn, flow from culture Droughts, heat waves, and floods are the new normal—unless policymakers get serious. Only the top strata requires intent. Direct violence is a deliberate act whereas structural violence results from “numerous acts of omission.” Structural violence is better understood as a process than an event. The suffering it causes can be many times greater than direct violence, but it goes unnoticed because it is depersonified and diffused across many people and different acts. It is the grinding inequality that holds minorities back year after year. Environmental inequalities are an example of structural violence. They too flow from deep cultural ideas about who is entitled to clean air and water and who is less “deserving.” Who must be kept safe and who is, to quote a Robert D. Bullard book title, the “[wrong complexion for protection](https://nyupress.org/9780814799932/the-wrong-complexion-for-protection/)”? Consider Archona and Priambandhu, who were farmers in Kaya Benia, a village in Bangladesh. In previous years, they had been able to produce two metric tons of rice from their 11 acres of land. After repeated cyclones and floods, their land has shrunk to two acres, and what remains is polluted with salt. It is underwater for four months of the year. “We don’t know the future, but we can assume that we will lose it all,” Archona said. “We are losing our home. We have lost our livelihood, and we are fighting to have enough food and water for each day. If we just had the land beneath our feet, then we could adapt to climate change.” Archona and Priambandhu have suffered an act of violence. Their home and their livelihood have been destroyed. Their land has been taken from them. They have contributed almost nothing to the crisis; this is something that has been done to them. The cause and the effect are so far apart from each other that it might not be recognized as violence. There was no malicious intent, yet their experience is all too common. As greenhouse gases pollute the atmosphere from the world’s most developed countries, the waters rise or the rains fall in faraway places. Heat waves claim the weakest. Crops are lost. Places and the memories they hold are erased. Cultural heritage is eroded. The individual events—the storms and cyclones—are sometimes described as “violent.” Why not the wider issue? If the cause and effect could be connected, perhaps it would be more obvious that expanding an airport, opening a new coal mine, or pulling out of an international treaty are acts of violence. They are acts of violence perpetrated against nature and biodiversity—and against people of color. One reason climate change is not seen as violence is it happens so gradually. This is a problem identified by Rob Dixon, a professor at Princeton University’s High Meadows Environmental Institute. He described how environmental harm progresses as “slow violence”: “a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all.” Climate change is nobody’s fault. Nobody intended it. It has not been designed. It has been “created by generations of decisions from privileged people who seek to make themselves safe and comfortable, who contribute disproportionately to the problem of climate change while tending to avoid its worst effects,” wrote Kevin J. O’Brien in his striking book *The Violence of Climate Change: Lessons of Resistance From Nonviolent Activists*. “It has no single architect and no direct cause, but it is nevertheless violence—a selfish expression of power that harms others.” There is a through line from George Floyd in Minneapolis to Archona and Priambandhu in Bangladesh. They have all suffered from acts of violence that spring from underlying patterns of inequality, where some people’s lives have greater value than others’ lives. The convenience of white consumers—the right to drive or fly or eat beef—takes precedence over the rights of people of color around the world. As demonstrators took to the streets of Minneapolis in May 2020, climate activists from the local branch of [350](https://350.org/about/) served food and provided first aid to protesters. Sam Grant, executive director and environmental justice campaigner, made the connection very clearly: “Police violence is an aspect of a broader pattern of structural violence, which the climate crisis is a manifestation of.” It is all part of the same struggle, the defiant cry that Black lives matter. The British media may have been wrong-footed by the actions of Black Lives Matter U.K. and their assertion that climate change is racist. African activists would have been less surprised. Maangamizi is a Swahili word that means havoc or annihilation. It has become a shorthand term for an “African holocaust” that stretches from slavery, through colonialism, and into current oppression and the threat of climate change. It is used by pan-African activists and academics, including a group that runs a petition called “Stop the Maangamizi: We charge genocide/ ecocide.” “We have our own understanding … of the problem of climate change, within the context of Pan-Afrikan Internationalism,” [write](https://www.opendemocracy.net/en/climate-justice-through-pan-afrikan-reparator/) Kofi Mawuli Klu and Esther Stanford-Xosei from the Pan-Afrikan Reparations Coalition in Europe. The group “sees climate change as one of the results of the criminal imposition—by the ruling classes of Europe—of a rapacious system expropriating the resources of the globe, not only at the expense of the majority of Humanity, but also to the detriment of our Mother Earth.” The term genocide is not an exaggeration. The first genocide of the 20th century was in German-controlled West Africa, a campaign called the Vernichtung that drove out the Herero and Nama tribespeople. The *Times of Israel* described it as a “template for the Holocaust.” Similar atrocities occurred in the Congo under Belgium, in Libya under Italian rule, and in the French colonies like Algeria. Other crimes may not fit the specific definition of genocide, but what is the right word for systematically obliterating an entire culture, as British imperialist forces did in the sacking of Benin? Although colonialism may have formally ended, pan-Africans argue justice is yet to be done and the damage is ongoing. As rapper [Akala](https://www.musixmatch.com/lyrics/Akala/Maangamizi) put it: “They changed that much? Are you so sure? The world’s darker people still the most poor?” This history of genocide and extraction of value from Africa is now being compounded by the climate crisis. It has taken different forms over the centuries, but the same pattern of cultural violence underlies slavery, colonization, unfair trade rules, and the climate crisis. First, it was the people and their labor. Then, it was the land and its resources. Now, it is the atmosphere. The nature of the plunder has changed, but the logic remains the same: White people are entitled to take what they need from Black people.

#### The billionaire space race has detrimental environmental impacts with no regulation halting it

Jessica Murray, 21 — [Guardian, “Half of emissions cuts will come from future tech, says John Kerry,” 5-16-2021, https://www.theguardian.com/environment/2021/may/16/half-of-emissions-cuts-will-come-from-future-tech-says-john-kerry, accessed 1-20-2022]

Last week [Virgin Galactic](https://www.theguardian.com/science/virgin-galactic) took Richard Branson past the edge of space, roughly 86 km up – part of a new space race with the Amazon billionaire Jeff Bezos, who aims to make a similar journey on Tuesday. Both very wealthy businessmen hope to vastly expand the number of people in space. “We’re here to make space more accessible to all,” [said Branson](https://www.reuters.com/lifestyle/science/virgin-galactics-branson-ready-space-launch-aboard-rocket-plane-2021-07-11/), shortly after his flight. “Welcome to the dawn of a new space age.” Already, people are buying tickets to space. Companies including [SpaceX](https://www.theguardian.com/science/spacex), Virgin Galactic and Space Adventures want to make space tourism more common. The Japanese billionaire Yusaku Maezawa spent an undisclosed sum of money with SpaceX in 2018 for a possible future private trip around the moon and back. And this June, an anonymous space lover paid $28m to fly on Blue Origin’s New Shepard with Bezos – though later backed out due to a [“scheduling conflict”](https://www.npr.org/2021/07/15/1016510564/blue-origin-space-18-year-old-bezos-oliver-daemen-netherlands). But this launch of a new private space industry that is cultivating tourism and popular use could come with vast environmental costs, says Eloise Marais, an associate professor of physical geography at University College London. Marais studies the impact of fuels and industries on the atmosphere. When rockets launch into space, they require a huge amount of propellants to make it out of the Earth’s atmosphere. For SpaceX’s Falcon 9 rocket, it is kerosene, and for Nasa it is liquid hydrogen in their new [Space](https://www.theguardian.com/science/space) Launch System. Those fuels emit a variety of substances into the atmosphere, including carbon dioxide, water, chlorine and other chemicals. The carbon emissions from rockets are small compared with the aircraft industry, she says. But they are increasing at nearly 5.6% a year, and Marais has been running a simulation for a decade, to figure out at what point will they compete with traditional sources we are familiar with. “For one long-haul plane flight it’s one to three tons of carbon dioxide [per passenger],” says Marais. For one rocket launch 200-300 tonnes of carbon dioxide are split between 4 or so passengers, according to Marais. “So it doesn’t need to grow that much more to compete with other sources.” Right now, the number of rocket flights is very small: in the whole of 2020, for instance, there were 114 attempted orbital launches in the world, according to Nasa. That compares with the airline industry’s more than 100,000 flights each day on average. But emissions from rockets are emitted right into the upper atmosphere, which means they stay there for a long time: two to three years. Even water injected into the upper atmosphere – where it can form clouds – can have warming impacts, says Marais. “Even something as seemingly innocuous as water can have an impact.” Closer to the ground, all fuels emit huge amounts of heat, which can add ozone to the troposphere, where it acts like a greenhouse gas and retains heat. In addition to carbon dioxide, fuels like kerosene and methane also produce soot. And in the upper atmosphere, the ozone layer can be destroyed by the combination of elements from burning fuels. “While there are a number of environmental impacts resulting from the launch of space vehicles, the depletion of stratospheric ozone is the most studied and most immediately concerning,” wrote Jessica Dallas, a senior policy adviser at the New Zealand Space Agency, in an analysis of [research on space launch emissions](https://www.sciencedirect.com/science/article/abs/pii/S0959652620302560) published last year. Another [report from 2019](https://aerospace.org/sites/default/files/2018-05/RocketEmissions_0.pdf) penned by the Center for Space Policy and Strategy likened the space emissions problem to that of space debris, which the authors say creates an existential risk to the industry. “Today, launch vehicle emissions present a distinctive echo of the space debris problem. Rocket engine exhaust emitted into the stratosphere during ascent to orbit adversely impacts the global atmosphere,” they wrote. “We just don’t know how large the space tourism industry could become,” says Marais. A new market report estimates that the global suborbital transportation and space tourism market is estimated to reach $2.58bn in 2031, growing 17.15% each year of the next decade. “The major driving factor for the market’s robustness will be focused efforts to enable space transportation, emerging startups in suborbital transportation, and increasing developments in low-cost launching sites,” the [report](https://www.prnewswire.com/news-releases/outlook-on-the-sub-orbital-transportation-and-space-tourism-global-market-to-2031---featuring-blue-origin-spacex-and-virgin-galactic-among-others-301333701.html) says. In the past, most space transportation has been focused on cargo supply missions to the International Space Station and satellite launch services, but currently, this focus has shifted to in-space transportation, planetary explorations, crewed missions, suborbital transportation and space tourism. Several companies, including SpaceX, Blue Origin and Virgin Galactic, have been focusing on developing platforms such as rocket-powered suborbital vehicles that will enable the industry to carry out suborbital transportation and space tourism. People have pointed out that the money these billionaires have poured into space technology could be invested in making life better on our planet, where wildfires, heatwaves and other climate disasters are becoming more frequent as the globe warms up in the climate crisis. “Is anyone else alarmed that billionaires are having their own private space race while record-breaking heatwaves are sparking a ‘fire-breathing dragon of clouds’ and cooking sea creatures to death in their shells?” the former US Labor Secretary Robert Reich [tweeted](https://twitter.com/RBReich/status/1413266215385001986) last week. Marais says that there is always an element of excitement to new developments in space – but it’s still possible to be responsible while doing something exciting. She urges caution as the space tourism industry grows, and says there are currently no international rules around the kinds of fuels used and their impact on the environment. “We have no regulations currently around rocket emissions,” she says. “The time to act is now – while the billionaires are still buying their tickets.”

#### Climate genocide is guaranteed, probability, magnitude and scale 100 percent

David Wallace-Wells, 18 — [David Wallace-Wells, “UN says Climate Genocide Is Coming. It’s Actually Worse Than That.,” Intelligencer, 10-10-2018, https://nymag.com/intelligencer/2018/10/un-says-climate-genocide-coming-but-its-worse-than-that.html, accessed 1-20-2022]

Just two years ago, amid global fanfare, the Paris climate accords were signed — initiating what seemed, for a brief moment, like the beginning of a planet-saving movement. But almost immediately, the international goal it established of limiting global warming to two degrees Celsius began to seem, to many of the world’s most vulnerable, [dramatically inadequate](https://psmag.com/environment/the-climate-change-debate-is-about-rising-temperatures); the Marshall Islands’ representative gave it a blunter name, calling two degrees of warming “genocide.” The [alarming new report](http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf) you may have read about this week from the UN’s Intergovernmental Panel on Climate Change — which examines just how much better 1.5 degrees of warming would be than 2 — echoes the charge. “Amplifies” may be the better term. Hundreds of millions of lives are at stake, the report declares, should the world warm more than 1.5 degrees Celsius, which it will do as soon as 2040, if current trends continue. Nearly all coral reefs would die out, wildfires and heat waves would sweep across the planet annually, and the interplay between drought and flooding and temperature would mean that the world’s food supply would become dramatically less secure. Avoiding that scale of suffering, the report says, requires such a thorough transformation of the world’s economy, agriculture, and culture that “there is no documented historical precedent.” The New York Times [declared](https://www.nytimes.com/2018/10/07/climate/ipcc-climate-report-2040.html) that the report showed a “strong risk” of climate crisis in the coming decades; in Grist, Eric Holthaus [wrote that](https://grist.org/article/scientists-calmly-explain-that-civilization-is-at-stake-if-we-dont-act-now/) “civilization is at stake.” If you are alarmed by those sentences, you should be — they are horrifying. But it is, actually, worse than that — considerably worse. That is because the new report’s worst-case scenario is, actually, a best case. In fact, it is a beyond-best-case scenario. What has been called a genocidal level of warming is already our inevitable future. The question is how much worse than that it will get. Barring the arrival of dramatic new carbon-sucking technologies, which are so far from scalability at present that they are best described as fantasies of industrial absolution, it will not be possible to keep warming below two degrees Celsius — the level the new report describes as a climate catastrophe. As a planet, we are coursing along a trajectory that brings us north of four degrees by the end of the century. The IPCC is right that two degrees marks a world of climate catastrophe. Four degrees is twice as bad as that. And that is where we are headed, at present — a climate hell twice as hellish as the one the IPCC says, rightly, we must avoid at all costs. But the real meaning of the report is not “climate change is much worse than you think,” because anyone who knows the state of the research will find nothing surprising in it. The real meaning is, “you now have permission to freak out.” As recently as a year ago, when I [explored](http://nymag.com/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html) worst-case scenarios for climate change, alarmism of this kind was considered anathema to many scientists, [who believed that storytelling that focused on the scary possibilities was just as damaging to public engagement as denial.](https://www.washingtonpost.com/opinions/doomsday-scenarios-are-as-harmful-as-climate-change-denial/2017/07/12/880ed002-6714-11e7-a1d7-9a32c91c6f40_story.html?noredirect=on&utm_term=.21f14fb70c92) There have been a few scary developments in climate research over the past year — more methane [from Arctic lakes](https://www.newsweek.com/arctic-permafrost-lakes-bubbling-methane-nasa-1119624) and [permafrost](https://www.hcn.org/issues/50.3/an-unfrozen-north) than expected, which could accelerate warming; [an unprecedented heat wave, arctic wildfires, and hurricanes rolling through both of the world’s major oceans this past summer](http://nymag.com/daily/intelligencer/2018/07/climate-change-wildfires-heatwave-media-old-news-end-of-the-world.html). But by and large the consensus is the same: We are on track for four degrees of warming, more than twice as much as most scientists believe is possible to endure without inflicting climate suffering on hundreds of millions or threatening at least parts of the social and political infrastructure we call, grandly, “civilization.” The only thing that changed, this week, is that the scientists, finally, have hit the panic button. Because the numbers are so small, we tend to trivialize the differences between one degree and two, two degrees and four. Human experience and memory offers no good analogy for how we should think about those thresholds, but with degrees of warming, as with world wars or recurrences of cancer, you don’t want to see even one. At two degrees, the melting of ice sheets will pass a tipping point of collapse, flooding dozens of the world’s major cities this century. At that amount of warming, it is estimated, global GDP, per capita, will be cut by 13 percent. Four hundred million more people will suffer from water scarcity, and even in the northern latitudes heat waves will kill thousands each summer. It will be worse in the planet’s equatorial band. In India, where many cities now numbering in the many millions would become unliveably hot, there would be 32 times as many extreme heat waves, each lasting five times as long and exposing, in total, 93 times more people. This is two degrees — practically speaking, our absolute best-case climate scenario. At three degrees, southern Europe will be in permanent drought. The average drought in Central America would last 19 months and in the Caribbean 21 months. In northern Africa, the figure is 60 months — five years. The areas burned each year by wildfires would double in the Mediterranean and sextuple in the United States. Beyond the sea-level rise, which will already be swallowing cities from Miami Beach to Jakarta, damages just from river flooding will grow 30-fold in Bangladesh, 20-fold in India, and as much as 60-fold in the U.K. This is three degrees — better than we’d do if all the nations of the world honored their Paris commitments, which none of them are. Practically speaking, barring those dramatic tech deus ex machinas, this seems to me about as positive a realistic outcome as it is rational to expect. At four degrees, there would be eight million cases of dengue fever each year in Latin America alone. Global grain yields could fall by as much as 50 percent, producing annual or close-to-annual food crises. The global economy would be more than 30 percent smaller than it would be without climate change, and we would see at least half again as much conflict and warfare as we do today. Possibly more. Our current trajectory, remember, takes us higher still, and while there are many reasons to think we will bend that curve soon — the plummeting cost of renewable energy, the growing global consensus about phasing out coal — it is worth remembering that, whatever you may have heard about the green revolution and the price of solar, at present, global carbon emissions are still growing. None of the above is news — most of that data is drawn from [this single, conventional-wisdom fact sheet](https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/). In fact, nothing in the IPCC report is news, either; not to the scientific community or to climate activists or even to anyone who’s been a close reader of new research about warming over the last few years. That is what the IPCC does: It does not introduce new findings or even new perspectives, but rather corrals the messy mass of existing, pedigreed scientific research into consensus assessments designed to deliver to the policymakers of the world an absolutely unquestionable account of the state of knowledge. Almost since the panel was convened, in 1988, it has been criticized for being too cautious in its assessment of the problem — a large body of temperamentally cautious scientists zeroing on those predictions they can all agree on (and which, they may have hoped, policymakers might find workable). The panel’s [Wikipedia page](https://en.wikipedia.org/wiki/Intergovernmental_Panel_on_Climate_Change) has separate subsections for “Outdatedness of reports” and “Conservative nature of IPCC reports.” Which is why it is so remarkable that the tone of this report is so alarmist — it’s not that the news about climate has changed, but that the scientific community is finally discarding caution in describing the implications of its own finding. They have also, thankfully, offered a practical suggestion, proposing the imposition of a carbon tax many, many times higher than those currently in use or being considered — they propose raising the cost of a ton of carbon possibly as high $5,000 by 2030, a price they suggest may have to grow to $27,000 per ton by 2100. Today, the average price of carbon across 42 major economies is just [$8 per ton](http://www.oecd.org/environment/few-countries-are-pricing-carbon-high-enough-to-meet-climate-targets.htm). The new Nobel laureate in economics, William Nordhaus, made his name by almost inventing the economic study of climate change, and his preferred carbon tax is $40 per ton — [which would probably land us at about 3.5 degrees of warming](http://www.pnas.org/content/114/7/1518). He considers that grotesque level “optimal.” But a carbon tax is only a spark to action, not action itself. And the action needed is at a scale and a speed almost unimaginable to most of us. The IPCC report called it unprecedented. Other activists often see one precedent, in all of human history, citing the model of how the United States prepared for World War II, and calling for a global mobilization of that kind — all of the world’s rivalrous societies and nationalistic governments and self-interested industries organized around the common pursuit of a stable and comfortable climate as though warming was an existential threat. It is. And the World War II mobilization metaphor is not hyperbole. To avoid warming of the kind the IPCC now calls catastrophic requires a complete rebuilding of the entire energy infrastructure of the world, a thorough reworking of agricultural practices and diet to entirely eliminate carbon emissions from farming, and a battery of cultural changes to the way those of us in the wealthy West, at least, conduct our lives. And we need to do all of that in two, or possibly three, decades. As a comparison, simply the last phase of the recent three-stop extension of New York City’s Second Avenue subway line took 12 years. All told, from the first groundbreaking, the project took 45 years. That is not to say it’s over or we’re doomed. Stalling warming below four degrees is better than surpassing it, keeping temperatures below three is better still, and the closer we get to two degrees the more miraculous. That is because climate change isn’t binary, and doesn’t just kick in, full force, at any particular temperature level; [it’s a function that gets worse over time as long as we produce greenhouse gases.](http://nymag.com/daily/intelligencer/2017/10/why-this-isnt-the-new-normal-for-climate-change.html) How long we continue to is, really, up to us, which is to say it will be determined in the province of politics, which is to say public panic like that produced by the IPCC report can be a very productive form of policy pressure. There are also those far-fetched alternatives I mentioned — carbon capture and solar geoengineering — but each is [far from workable at the moment](http://nymag.com/daily/intelligencer/2018/03/the-paris-climate-accords-are-starting-to-look-like-fantasy.html) and, even in theory, [come with really scary drawbacks](http://nymag.com/daily/intelligencer/2018/08/solar-geoengineering-climate-change.html). But even if the technology becomes dramatically cheaper and more efficient over the next few years, you would need to build them out across the globe, as well — whole plantations sucking carbon almost everywhere on the planet. It will take quite a long time to build those, in other words, even if they worked, and we simply don’t have that many years left to act. A few weeks ago, as the IPCC report loomed, I had lunch with a prominent climate scientist who’d been involved in earlier reports and has done considerable work on local preparedness as well. I asked if he thought New York would eventually build a sea wall or surge barrier to protect the city from sea-level rise and flooding. Yes, he said, Manhattan will be protected, at any cost. But major infrastructure projects like these take decades — typically about 30 years. Even if we began building today, he said, the barrier would not be finished in time to save Howard Beach and other parts of southern Queens and Brooklyn. Soon enough, he said, you’ll see the city adjust accordingly — halting new infrastructure projects there, eventually pulling back from even quotidian maintenance like sewer repairs and generally signaling to current residents that they will not be able to leave behind their homes, when they die, to their children. And of course a sea wall to protect New York only encloses the narrows of New York Harbor, leaving all of Long Island exposed. This is just the threat from sea level, and just one (very rich) metropolitan area. The world is much bigger than that, but so is climate change. It is also very fast, with more than half the carbon humanity has ever emitted into the atmosphere having come in just the last 25 years, since Al Gore published his first book on climate change. Monday’s IPCC may seem like a dramatic departure, and it is. But there is going to be much more like it coming. So long as we continue to squander what little time we have, the news will only get worse from here.

#### We can solve but only through regulation and restriction of the private space industry

David Verbeek and Helene Fouquet, 17 — [By&nbsp;David Verbeek and Helene Fouquet, “Can we get to space without damaging the Earth through huge carbon emissions?,” Los Angeles Times, 7-14-2017, https://www.latimes.com/business/story/2020-01-30/space-launch-carbon-emissions, accessed 1-20-2022]

When a SpaceX Falcon Heavy rocket blasts off on a plume of white smoke, hot gases shoot out of its 27 engines, creating a thrust equal to 18 Boeing 747 aircraft. Upon reaching orbit, the world’s heaviest operational rocket will have burned about 400 metric tons of kerosene and emitted more carbon dioxide in a few minutes than an average car would in more than two centuries. That kind of shock to the atmosphere is stoking concerns about the effect that launching into orbit has on Earth, and it’s about to get worse. Fueled by surging data transmissions and the race for commercial space flights between Elon Musk’s Space Exploration Technologies Corp., Jeff Bezos’ Blue Origin and Richard Branson’s Virgin Galactic Holdings Inc., the number of launches — including giants such as the Falcon Heavy and new mini-rockets — is expected to increase tenfold to roughly 1,000 annually in the coming years Although there are no regulations on rocket emissions, new space pioneers are taking it upon themselves to develop launchers that make leaving the atmosphere less damaging to the planet. It’s less space cowboy and more space boy scout. “Climate change is real, and we don’t want to make it worse,” said Chris Larmour, chief executive of British rocket maker Orbex. The start-up, founded in 2015 and which has a contract with U.S. launch integrator TriSept Corp., uses bio-propane that it says can cut CO2 emissions by 90% compared with traditional launch fuel. Besides greenhouse gas pollution, kerosene-fueled rockets transport large amounts of black carbon, also known as soot, into the upper layers of the atmosphere. There, it remains for a long time, creating an umbrella that may add to global warming. The fuel is widely used because it’s easier to handle than fuels such as hydrogen. “So far the only criteria for everyone to build rockets was performance and cost,” said Jean-Marc Astorg, director for launch vehicles at French space agency CNES. “Environment was not a priority at all. That’s changing.” The urgency to clean up rocket emissions is intensifying. Last year, the space industry launched 443 satellites, more than three times as many as a decade earlier, according to the United Nations Office for Outer Space Affairs. Planned missions to the moon and Mars will increase the strain on the environment. SpaceX alone is planning to launch 12,000 satellites in the next seven years for its [Starlink internet constellation](https://www.latimes.com/business/story/2019-12-07/spacex-starlink-service). The company is developing the methane-powered Raptor engine, burning the greenhouse gas with a view to refueling on Mars. Blue Origin’s strategy is potentially more environmentally friendly, with plans for liquid hydrogen to propel its reusable rockets. Virgin Galactic says its plans represent a “new age of clean and sustainable access to space.” The company relies on lightweight spaceships that can fly hundreds of times to mitigate its environmental effect and says its rockets burn for only 60 seconds. The carbon footprint for passengers will be in line with a transatlantic business-class seat, it says. ArianeGroup is going a step further. Europe’s biggest launch company is working on a rocket that aims to be carbon-neutral by running on methane produced from biomass. Dubbed Ariane Next, the heavy-launcher project targets liftoff in 2030. “The rest of the world is lagging Europe so far on the environment performance of their future engines and launchers,” Astorg said. Smaller challengers such as Orbex are moving quickly. The company, which is funded by a mix of venture capital and public funds, plans to have its Prime rocket take its maiden flight at the end of 2021. In addition to cutting CO2, the rocket will completely avoid black carbon, which is a “much bigger climate problem,” Larmour said. Reducing soot and CO2 by 25% to 40% is more realistic, said Daniel Metzler, CEO of the German rocket start-up ISAR Aerospace, founded in 2018. His rocket — also scheduled to lift off in late 2021 — will decrease soot pollution by using a liquid fuel based on a light hydrocarbon, Metzler said, declining to provide specifics. Such aggressive reductions in soot pose design and production challenges because the fuel residue has the positive side effect of protecting the inner surface of the combustion chamber against heat, the 27-year-old engineer said. ISAR addresses the problem by guiding the in-flowing fuel through a system of channels to cool the engine. Like Orbex, the company relies on 3-D printers to create the complex structures. Rocket Factory Augsburg, a unit of German satellite maker OHB, took environmental issues into account from the start in developing its “mini-launcher,” an emerging trend in the aerospace industry. The rocket — developed for transporting small satellites and scheduled to perform its maiden flight next year — is using a new environmentally friendly propellant. All of the ingredients are “available in a do-it-yourself-store,” and the design has the potential to avoid hydrazine, a highly toxic liquid used to fuel upper stages and satellites, Chief Engineer Stefan Brieschenk said. The RFA launcher is designed to “avoid CO2 and soot as much as possible” because it’s the right thing to do, the 34-year-old said. “We are all young people, and we want to make a change now.” Joern Spurmann, RFA program manager, sums up the new approach to the space race: “We’re following the boy scout rule that says: Leave the campground cleaner than you found it.”

## Backline: Debris Solved w/ Time

#### Climate Change Increases Space Debris

**O’Callaghan 5/24** Johnathan O’Callaghan. "What if Space Junk and Climate Change Become the Same Problem?." The New York Times, 12 May 2021, https://www.nytimes.com/2021/05/12/science/space-junk-climate-change.html. Accessed 25 Jul. 2021.

It’s easy to compare the space junk problem to climate change. Human activities leave too many dead satellites and fragments of machinery discarded in Earth orbit. If left unchecked, space junk could pose significant problems for future generations — rendering access to space increasingly difficult, or at worst, impossible. Yet the two may come to be linked. Our planet’s atmosphere naturally pulls orbiting debris downward and incinerates it in the thicker lower atmosphere, but increasing carbon dioxide levels are lowering the density of the upper atmosphere, which may diminish this effect. A study presented last month at the European Conference on Space Debris says that the problem has been underestimated, and that the amount of space junk in orbit could, in a worst-case scenario, increase 50 times by 2100. “The numbers took us by surprise,” said Hugh Lewis, a space debris expert from the University of Southampton in England and a co-author on the paper, which will be submitted for peer review in the coming months. “There is genuine cause for alarm.” Our atmosphere is a useful ally in clearing up space junk. Collisions with its molecules cause drag, pulling objects back into the atmosphere. Below 300 miles above the surface, most objects will naturally decay into the thicker lower atmosphere and burn up in less than 10 years. At lower altitudes, infrared radiation is trapped by the thick atmosphere as heat. But above 60 miles where the atmosphere is thinner, the opposite is true. “There’s nothing to recapture that energy,” said Matthew Brown, also from the University of Southampton and the paper’s lead author. “So it gets lost into space.” A piece of debris that strayed from the Earth-orbiting Space Shuttle Challenger in February 1984. Today, more than 2,500 objects larger than four inches currently orbit at or below an altitude of 250 miles. The escape of heat causes the volume of the atmosphere to decrease. This results in atmospheric contraction, which reduces its density at a given altitude. Since 2000, Mr. Brown and his team say the atmosphere at 250 miles has lost 21 percent of its density because of rising carbon dioxide levels. By 2100, if carbon dioxide levels double their current levels — in line with the worst-case scenario assessment by the Intergovernmental Panel on Climate Change — that number could rise to 80 percent. For space junk, the implications are stark. More than 2,500 objects larger than four inches in size currently orbit at or below an altitude of 250 miles. In the worst-case scenario, increased orbital lifetimes of up to 40 years would mean fewer items are dragged into the lower atmosphere. Objects at this altitude would proliferate by 50 times [up] to about 125,000. Even in a best-case scenario, where carbon dioxide levels stabilize or even reverse, the amount of space junk would still be expected to double. Mr. Brown thinks a more probable outcome is somewhere in between, perhaps a 10 or 20 times increase. The research is “very important work,” said John Emmert, an atmospheric scientist at the U.S. Naval Research Laboratory in Washington, D.C., who has studied atmospheric density loss. However, Dr. Emmert says more research is needed to understand the severity of the problem — with the impact of the sun’s solar cycle also known to be a major factor in atmospheric density changes.

Cyclical

## Frontline: Debris Cleaned Up

#### **Legal problems makes space debris clean up impossible**

Michael Listner 12 [Michael Listner. . “The Space Review: Legal issues surrounding space debris remediation”. 8-6-2012. The Space Review. https://thespacereview.com/article/2130/1. Accessed 7-25-2021]

Space debris is considered by many to be the most prominent issue in the arena of outer space security and safety. More than a half-century of space activities by the various spacefaring nations have left a debris environment that is self-perpetuating and threatens to render the outer space environment useless, particularly in low Earth orbit. Space debris ranges in size from fragments less than a millimeter in diameter to complete spacecraft many meters across. The nature of this debris includes intact satellites, rocket bodies, fragments from exploded rocket bodies, fragments from collisions, and objects from extracurricular activities. Without consent from the nation that launched and operates or otherwise owns the satellite or space object, it cannot be disposed of or otherwise interfered with. Addressing the issue of space debris is two-fold. First, there is mitigation, which through practices by space-faring nations such the space debris mitigation guidelines promulgated by the UN.1 These guidelines are not binding upon member states of the UN and only a few of the spacefaring nations have implemented them as mandatory requirements into their space programs. However, remediation or removal of existing space debris is another matter, and the methodologies of which are still in its infancy and face substantial technical, financial and political hurdles. Additionally, space debris remediation also faces major legal issues. The purpose of this essay is to attempt to identify and briefly discuss some of those legal challenges and their potential solutions, including a definition of space debris that could facilitate space debris remediation. This essay is should not be considered and exhaustive discussion on the topic. The most prominent issue surrounding cleanup of orbital space debris rests with Article VIII of the Outer Space Treaty, in which space objects, including nonfunctioning satellites and other space debris, continue to belong to the country or countries that launched them.2 There is no right of salvage analogous to the right found in maritime law, which means that even though a satellite or some other space object may not be functioning, it does not imply that it has been abandoned by the nation that launched it. Without consent from the nation that launched and operates or otherwise owns the satellite or space object, it cannot be disposed of or otherwise interfered with. This is further complicated by the fact that international space law deems fragments and components from space objects as individual space objects in and of themselves, which would require identification to determine the owner and either individual or blanket consent to remove it from orbit. Ancillary to ownership are issues dealing with licensing and compliance with International Traffic in Arms Regulations (ITAR). Methodologies to remove intact derelict satellites may include the use of mechanisms that will rendezvous, attach, and physically move the derelict from a stable orbit to either a graveyard orbit, where it will not interfere with other space objects, or into a less stable orbit that would ensure the destruction of the derelict within a short period of time. This methodology of space debris removal requires an intimate knowledge of the spacecraft so that an effort to remove it would not result in fragmentation and the creation of additional space debris, which in the case of space objects belonging to the United States could trigger ITAR. Compounding the ITAR issue is that of intellectual property rights. Disclosure of sufficient technical details regarding a derelict spacecraft could implicate intellectual property, including confidential and proprietary technical information as well as patents. Licensing agreements between the owners and former operators of the derelict satellites would have to be negotiated, as would confidentiality and nondisclosure agreements to protect the rights of the owners. Furthermore, ITAR issues could arise if a derelict satellite registered to the United States is slated for removal by a methodology operated by a foreign government, especially if exporting of spacecraft-related technical data outside the United States is involved. Before such exporting and subsequent satellite disposal could take place, licenses or other waivers would be required to address these issues. Any discussion of legal issues would not be complete without noting the issue of liability. Removal of space debris will presumably be carried out by governmental organizations and nongovernmental organizations (NGOs), either exclusively or concurrently. Removal of space debris is not without risk, and regardless of whether NGOs or governmental organizations are performing the activity, Article VI of the Outer Space Treaty requires that the country under whose jurisdiction they fall retain responsibility for their activities and any accidents during their activities.3 Complicating the responsibility under Article VI of the Outer Space Treaty, the Liability Convention takes the issue of liability in Article VII of the Outer Space Treaty a step forward. The Liability Convention envisions two scenarios where damage could be caused by a space object. The first scenario envisions a space object that causes damage to the surface of the Earth or an aircraft in flight, which applies a strict liability standard. The second scenario envisions an event where a space object causes damage someplace other than the surface of the Earth, i.e. outer space or another celestial body, and applies a fault standard.4