#### **The standard is maximizing expected foreseen well-being.**

#### **Pleasure is both unconditionally and intrinsically valuable.**

**Goldstein 89** [Irwin Goldstein, “Pleasure and Pain: Unconditional, Intrinsic Values”, Philosophy and Phenomenological Research , Dec., 1989, Vol. 50, No. 2 (Dec., 1989), pp. 255-276, International Phenomenological Society,<https://www.jstor.org/stable/2107959?seq=1#metadata_info_tab_contents>, Irvin Goldstein was a philosophy professor at Davidson College for 31 years] //Lex AKu

What is good overall, right, or obligatory varies according to effects. Each is context-dependent and may vary across cultures. Evaluations of what is so universally are hazardous; such high level principles seem inevitably to meet expectations. We need not expect exertion to be good overall univer- sally: its value hinges on effects, which vary. What is right may vary with context and so cross-culturally. Even stealing and killing are sometimes right (Noddings, i984: 93). If he is using 'moral demands' to designate duties (actual, not prima facie) and to exclude intrinsic badness, Gilbert Harman may be correct in saying "there are no basic moral demands that apply to everyone" (I984: 27). Though calling all members in a class good is risky, intrinsic universal evaluations can be less precarious than other universal evaluations. **Pleasure's intrinsic worth is not context-dependent and so not subject to con- textual fluctuations**. **When in pain, I can immediately recognize bad even if I am oblivious to the sensation's context and indifferent to moral considerations; pain's intrinsic badness is not founded in and so potentially undermined by pain's surroundings.** Because we direct so many evalua- tions to what is good overall or morally good, much of what we justly call 'good' simpliciter is good only in some circumstances. **This helps camouflage the fact that pleasure and other value-conferring ends are good in themselves unconditionally**. **Pleasure is good as such, because of its pleasurableness, not because of some further good quality which colors pleasure and may or may not be present**. **The foundation of pleasure's goodness, its pleasurableness, marks every pleasure.** How could pleasure fail to be intrinsically good? G. E. Moore's reasoning resembles mine when he writes that a judgment of intrinsic goodness "if true of one instance of the thing in question, is necessarily true of all" (1903: 27). **Since at least some pleasure is good intrinsically simply because of its pleasurableness, pleasure should always be good intrinsically, whatever the society, and so be an unconditional value.** Pleasure's standing as an intrinsic value is founded in pleasure's nature. **Appreciating its value and understanding what pleasure is are not inde- pendent projects. Intrinsic goodness** is not merely incidental to pleasure; I suggest it **is fundamental to what makes an experience pleasure**. **As hot and cold are opposites in temperature and north and south in direction, so pleasure and pain**, both physical and emotional, **are opposites in intrinsic agreeability**. Heat is ipso facto, and thus always, linked to high tempera- ture; so, achieved in a virtuous or vicious activity, **pleasure in itself is ipso facto and so always agreeable and pain ipso facto and so always disagree- able**. I propose that **pleasure's goodness -** which for me is, in part, its char- acter of affording valid, intrinsic grounds for desire - **fixes pleasure's agreeableness, and pain's badness dictates its disagreeableness.**' Plea- sure and pain, then, contrast with experiences of warmth or coldness, which are linked to value only incidentally: pleasure and pain are oppo- sites through their opposing intrinsic worth. For every pleasure, intrinsic goodness is fundamental to what marks a psychological occurrence, localized or nonlocalized, as pleasure. **Grounding dislike, having dis- value, is a defining feature of the unpleasant and so common to all unpleasantness.** This view of pleasure answers pluralists, who detect no property shared by all pleasure which unites the diverse phenomena we label 'pleasure' into a single class.'6 The interrelated properties of pleasure's agreeable- ness, its natural tendency to attract sentient beings and, more fundamen- tally, its intrinsic nonmoral goodness and intrinsic grounding of desire unify the psychological occurrences, localized and nonlocalized, we label 'pleasure'. Pain, physical and emotional, forms a single class opposite to pleasure through its disagreeableness, its tendency to repel, its intrinsic badness and grounding of aversion."

#### **2] Actor specificity: A] Governments must aggregate since every policy benefit some and harms others, which also means side constraints freeze action. B] States lack wills or intentions since policies are collective actions. C] No act omission distinction---choosing to omit is an act itself – people psychologically decide not to act.**

#### **3] Ground – every impact function under util whereas other ethics can flow to one side exclusively. Util ensures equal playing field since affirmatives have different advantage areas and negs can read different pics, cps and disads. Kills fairness since we both need equal playing field.**

#### **4] Extinction is the biggest impact.**

**Pummer 15** [Theron, Junior Research Fellow in Philosophy at St. Anne's College, University of Oxford. “Moral Agreement on Saving the World” Practical Ethics, University of Oxford. May 18, 2015] AT

**There appears to be lot of disagreement in moral philosophy. Whether these many apparent disagreements are deep and irresolvable, I believe there is at least one thing it is reasonable to agree on right now**, whatever general moral view we adopt**: that it is very important to reduce the risk that all intelligent beings on this planet are eliminated by an enormous catastrophe, such as a nuclear war.** How we might in fact try to reduce such existential risks is discussed elsewhere. My claim here is only that **we – whether we’re consequentialists, deontologists, or virtue ethicists – should all agree that we should try to save the world.** According to consequentialism, we should maximize the good, where this is taken to be the goodness, from an impartial perspective, of outcomes. **Clearly one thing that makes an outcome good is that the people in it are doing well. There is little disagreement here.** If the happiness or well-being of possible future people is just as important as that of people who already exist, and if they would have good lives, it is not hard to see how **reducing existential risk is easily the most important thing in the whole world. This is for the familiar reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. There are s’o many possible future people that reducing existential risk is arguably the most important thing in the world, even if the well-being of these possible people were given only 0.001% as much weight as that of existing people.** Even on a wholly person-affecting view – according to which there’s nothing (apart from effects on existing people) to be said in favor of creating happy people – the case for reducing existential risk is very strong. As noted in this seminal paper, **this case is strengthened by the fact that there’s a good chance that many existing people will, with the aid of life-extension technology, live very long and very high quality lives. You might think what I have just argued applies to consequentialists only. There is a tendency to assume that, if an argument appeals to consequentialist considerations (the goodness of outcomes), it is irrelevant to non-consequentialists. But that is a huge mistake.** **Non-consequentialism is the view that there’s more that determines rightness than the goodness of consequences or outcomes; it is not the view that the latter don’t matter.** Even John Rawls wrote, “**All ethical doctrines worth our attention take consequences into account in judging rightness. One which did not would simply be irrational, crazy.**” **Minimally plausible versions of deontology and virtue ethics must be concerned in part with promoting the good, from an impartial point of view.** **They’d thus imply very strong reasons to reduce existential risk**, at least when this doesn’t significantly involve doing harm to others or damaging one’s character. What’s even more surprising, perhaps, is that even if our own good (or that of those near and dear to us) has much greater weight than goodness from the impartial “point of view of the universe,” indeed even if the latter is entirely morally irrelevant, we may nonetheless have very strong reasons to reduce existential risk. **Even egoism, the view that each agent should maximize her own good, might imply strong reasons to reduce existential risk.** It will depend, among other things, on what one’s own good consists in. If well-being consisted in pleasure only, it is somewhat harder to argue that egoism would imply strong reasons to reduce existential risk – perhaps we could argue that one would maximize her expected hedonic well-being by funding life extension technology or by having herself cryogenically frozen at the time of her bodily death as well as giving money to reduce existential risk (so that there is a world for her to live in!). I am not sure, however, how strong the reasons to do this would be. But views which imply that, if I don’t care about other people, I have no or very little reason to help them are not even minimally plausible views (in addition to hedonistic egoism, I here have in mind views that imply that one has no reason to perform an act unless one actually desires to do that act). **To be minimally plausible, egoism will need to be paired with a more sophisticated account of well-being.** To see this, it is enough to consider, as Plato did, the possibility of a ring of invisibility – **suppose that, while wearing it, Ayn could derive some pleasure by helping the poor, but instead could derive just a bit more by severely harming them. Hedonistic egoism would absurdly imply she should do the latter. To avoid this implication, egoists would need to build something like the meaningfulness of a life into well-being**, in some robust way, where this would to a significant extent be a function of other-regarding concerns (see chapter 12 of this classic intro to ethics). But **once these elements are included, we can (roughly, as above) argue that this sort of egoism will imply strong reasons to reduce existential risk.** Add to all of this Samuel Scheffler’s recent intriguing arguments (quick podcast version available here) that most of what makes our lives go well would be ndermined if there were no future generations of intelligent persons. On his view, my life would contain vastly less well-being if (say) a year after my death the world came to an end. So obviously if Scheffler were right I’d have very strong reason to reduce existential risk. **We should also take into account moral uncertainty.** **What is it reasonable for one to do, when one is uncertain not (only) about the empirical facts, but also about the moral facts?** I’ve just argued that **there’s agreement among minimally plausible ethical views that we have strong reason to reduce existential risk – not only consequentialists, but also deontologists, virtue ethicists, and sophisticated egoists should agree.** But **even those (hedonistic egoists) who disagree should have a significant level of confidence that they are mistaken, and that one of the above views is correct. Even if they were 90% sure that their view is the correct one** (and 10% sure that one of these other ones is correct), **they would have pretty strong reason, from the standpoint of moral uncertainty, to reduce existential risk.** Perhaps most disturbingly still, **even if we are only 1% sure that the well-being of possible future people matters, it is at least arguable that, from the standpoint of moral uncertainty, reducing existential risk is the most important thing in the world.** Again, this is largely for the reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. (For more on this and other related issues, see this excellent dissertation). Of course, it is uncertain whether these untold trillions would, in general, have good lives. It’s possible they’ll be miserable. **It is enough for my claim that there is moral agreement in the relevant sense if**, at least given certain empirical claims about what future lives would most likely be like, **all minimally plausible moral views would converge on the conclusion that we should try to save the world.** While there are some non-crazy **views that place significantly greater moral weight on avoiding suffering than on promoting happiness**, for reasons others have offered (and for independent reasons I won’t get into here unless requested to), they nonetheless **seem to be fairly implausible views.** And **even if things did not go well for our ancestors, I am optimistic that they will overall go fantastically well for our descendants, if we allow them to. I suspect that most of us alive today – at least those of us not suffering from extreme illness or poverty – have lives that are well worth living, and that things will continue to improve.** Derek Parfit, whose work has emphasized future generations as well as agreement in ethics, described our situation clearly and accurately: “We live during the hinge of history. **Given the scientific and technological discoveries of the last two centuries, the world has never changed as fast.** We shall soon have even greater powers to transform, not only our surroundings, but ourselves and our successors. **If we act wisely in the next few centuries, humanity will survive its most dangerous and decisive period.** Our descendants could, if necessary, go elsewhere, spreading through this galaxy…. **Our descendants might, I believe, make the further future very good. But that good future may also depend in part on us. If our selfish recklessness ends human history, we would be acting very wrongly.**” (From chapter 36 of On What Matters)

#### **Plan: The appropriation of outer space by private entities is unjust.**

#### **Enforcement through banning constellations in the LEO by claiming they violate Article II of the OST, Johnson 20**

[Christopher D. Johnson, 2020, "The Legal Status of MegaLEO Constellations and Concerns About Appropriation of Large Swaths of Earth Orbit", Secure World Foundation, https://swfound.org/media/206951/johnson2020\_referenceworkentry\_thelegalstatusofmegaleoconstel.pdf, date accessed 1-23-2022] //Lex AT

**Are Constellations Appropriation? The astronomy community has already voiced concerns about the impact that constellations will have on astronomy** (AstronomyNow 2019). **Constellations also bring potential risks from space debris and radiofrequency interference, both of which will have an effect on space sustainability**. Starlink’s 1584 satellites in the 550 km region would effectively triple the number of satellites in the 400–600 km region, for example. Leaving these important concerns aside, **constellations should also be considered in the context of their general legal status – and specifically whether large swaths of Low Earth Orbit are being impermissibly claimed and possessed by individual actors** (whether the commercial actor itself, or by the authorizing national government). For example, and as mentioned above, the OneWeb constellation will be in 12 orbital planes at 1200 km. Phase 1 of the SpaceX Starlink constellations will fly 66 satellites in 24 orbital planes, for a total of 1584 satellites in its initial constellation. Do these megaconstellations constitute an impermissible appropriation (or ownership) of particular regions of outer space? Without offering a definitive conclusion, the following sections first argue why, and then why not, these large constellations in LEO constitute impermissible appropriations of sections of outer space. The reader can consider for themselves which of the following opposing arguments they find more convincing. Yes, **This Is Impermissible Appropriation Article II of the Outer Space Treaty**, discussed above, **is clear on the point that the appropriation of outer space, including the appropriation of either void space or of celestial bodies,** is an impermissible and prohibited action under international law. No means or methods of possession of outer space will legitimize the appropriation or ownership of outer space, or subsections thereof. Excludes Others **The constellations above, because they seem to so overwhelmingly possess particular orbits through the use of multiple satellites to occupy orbital planes, and in a manner that precludes other actors from using those exact planes, constitute an appropriation of those orbits.** **While the access to outer space is nonrivalrous** – in the sense that anyone with the technological capacity to launch space objects can therefore explore space – it is also true that **orbits closer to Earth are unique, and when any actor utilizes that orbit to such an extent to these proposed constellations will, it means that other actors simply cannot go there.** The Legal Status of MegaLEO Constellations and Concerns About Appropriation... 15 To allow SpaceX, for example, to so overwhelmingly occupy a number of altitudes with so many of their spacecraft, essentially means that SpaceX will henceforth be the sole owner and user of that orbit (at least until their satellites are removed). No other actors can realistically expect to operate there until that time. No other operator would dare run the risk of possible collision with so many other spacecraft in that orbit. Consequently, the sole occupant will be SpaceX, and if “possession is 9/10th of the law,” then SpaceX appears to be the owner of that orbit. Done Without Coordination Additionally, SpaceX and other operators of **megaconstellations are doing so without any real international conversation or agreement, which is especially egregious and transgressive of the norms of outer space**. Compared to the regime for GSO, as administered by the ITU and national frequency administrators, Low Earth Orbit is essentially ungoverned, and SpaceX and others are attempting to seize this lack of authority to claim entire portions of LEO for itself; and before any international agreement, consensus, or even discussion is had. They are operating on a purely “first come, first served” basis that smacks of unilateralism, if not colonialism. Governments Are Ultimately Implicated As we know, under international space law, what a nongovernmental entity does, a State is responsible for. **Article VI of the Outer Space Treaty requires that at least one State authorize and supervise its nongovernmental entities and assure their continuing compliance with international law. As such**, the prohibition on **nonappropriation** imposed upon States under Article II of the Outer Space Treaty **applies equally to nongovernmental private entities** such as SpaceX. Nevertheless, through the launching and bringing into use of the Starlink constellation, SpaceX will be the sole occupant, and thereby, possessor, both fact and in law, of 550 km, 1100 km, 1130 km, 1275 km, and 1325 km above our planet (or whatever orbits they finally come to occupy). The same is true for the other operators of these large constellations which will be solely occupying entire orbits.

#### **Exemptions destroy the coercive power of legal regimes – causes circumvention across the board.**

**Hickman and Dolman 2** – John and Everett, 2002, Associate professor in the Department of Government and International Studies at Berry College in Mt. Berry, [“Resurrecting the Space Age: A State–Centered Commentary on the Outer Space Regime,” Volume 21 Number 1,<https://doi.org/10.1080/014959302317350855>] Elmer Recut Justin

Thus a state party need merely announce its intention to withdraw and then wait one year. **Withdrawal** of a **single state party to the treaty**, however, would **not necessarily terminate the treaty** between the other state parties. Yet, the **decision of an important state** not to be bound by a regime–creating treaty obviously endangers the **entire treaty**. The decision of the United States or China to withdraw from the OST would have far greater implications for the survival of the international space regime than the same decision by Bangladesh, Burkina Faso, or Papua New Guinea—the equality of states under international law remains nothing more than a useful ction. For the OST to remain **good international law**, it must be accepted as such by the **major space faring states of the 21st Century**: the United States, Russia, the European Union, Japan, and China. **One defection** from the regime by a member of this group would no doubt lead to its **effective collapse**, as the remaining space faring states are **unlikely to use the kind of coercion necessary to enforce the regime**. A more likely response to such a defection is a scramble to make similar **claims to sovereignty**, based on **historical precedent** and effective **occupation**. Similar rushes to stake claims for territory sovereignty in other celestial bodies might follow.

### **Advantage**

#### **Private sector activity is driving LEO congestion and its set to get 100 times worse – the plan reverses this trend.**

**Smith 8/18** [Adam Smith, “Loopholes in Space Debris Law Might Stop Humanity from Leaving Earth.” *The Independent*, Independent Digital News and Media, 18 Aug. 2021, [https://www.independent.co.uk/life-style/gadgets-and-tech/space-debris-planet-legal-loophole-earth-government-b1897082.html.]//Lex](https://www.independent.co.uk/life-style/gadgets-and-tech/space-debris-planet-legal-loophole-earth-government-b1897082.html.%5d/Lex) AKu

If this is not addressed, **the scale of the problem is only going to get worse**. **SpaceX has launched more than 1,700 of its Starlink satellites into space in the last two years, which has almost singlehandedly doubled the active number of satellites in orbit. There are plans to launch tens of thousands more by commercial companies**, nation states or groups of nations **into Low Earth Orbit, adding to the congestion even more.** The **advent of mega constellations could also see the number LEO satellite increase by a factor of 100 fold to nearly 100,000 satellites orbiting the Earth by 2030, leading to vastly more potential collisions which would result in the generation of significant amounts of debris**, Peter Hadinger and Mark Dickinson, the Chief Technology Officer and Head of Satellite Operations at British satellite telecommunications company Inmarsat, told *The Independent*. The average impact speed of a piece of orbital debris colliding with another object is approximately 36,000 km per hour – seven times faster than a speeding bullet. “The parallels with climate change are clear, and as a space community we should learn the lessons that proactive and early management is required ensuring we don’t wait until the damage is done”, they added. Fortunately, **there is time left for humanity to rectify its situation**. Low altitude space (550 kilometres) can recover from a series of fragmentations over approximately half a decade, Aaron C. Boley, associate physics professor at The University of British Columbia, told The Independent – although higher altitudes (700 kilometres) can take ten times as long to recover.

#### **Privatization of space will increase space debris collisions, Muelhaupt 19**

[Theodore J. Muelhaupt, June 2019, "Space traffic management in the new space era", [Journal of Space Safety Engineering](https://www.sciencedirect.com/science/journal/24688967), https://www.sciencedirect.com/science/article/pii/S246889671930045X?via%3Dihub, date accessed 1-23-2022] //Lex AT

**The last decade has seen rapid growth and change in the space industry, and an explosion of commercial and private activity**. Terms like NewSpace or democratized space are often used to describe this global trend to develop faster and cheaper access to space, distinct from more traditional government-driven activities focused on security, political, or scientific activities. The easier access to space has opened participation to many more participants than was historically possible. **This new activity could profoundly worsen the space debris environment, particularly in low Earth orbit (LEO),** but there are also signs of progress and the outlook is encouraging. Many NewSpace operators are actively working to mitigate their impact. Nevertheless, NewSpace represents a significant break with past experience and business as usual will not work in this changed environment. New standards, space policy, and licensing approaches are powerful levers that can shape the future of operations and the debris environment. 2. Characterizing NewSpace: a step change in the space environment In just the last few years, commercial companies have proposed, funded, and in a few cases begun deployment of very large constellations of small to medium-sized satellites. These constellations will add much more complexity to space operations. Table 1 shows some of the constellations that have been announced for launch in the next decade. **Two dozen companies, when taken together, have proposed placing well over 20,000 satellites in orbit in the next 10 years.** **For perspective, fewer than 8100 payloads have been placed in Earth orbit in the entire history of the space age, only 4800 [1] remain in orbit and approximately 1950** [2] **of those are still active**. **And it isn't simply numbers – the mass in orbit will increase substantially, and long-term debris generation is strongly correlated with mass**. This table is in constant flux. It is based largely on U.S. filings with the Federal Communications Commission (FCC) and various press releases, but many of the companies here have already altered or abandoned their original plans, and new systems are no doubt in work. Although many of these large constellations may never be launched as listed, **the traffic created if just half are successful would be more than double the number of payloads launched in the last 60 years and more than 6 times the number of currently active satellites.** Current space safety, space surveillance, collision avoidance (COLA) and debris mitigation processes have been designed for and have evolved with the current population profile, launch rates and density of LEO space. By almost any metric used to measure activity in space, whether it is payloads in orbit, the size of constellations, the rate of launches, the economic stakes, the potential for debris creation, the number of conjunctions, NewSpace represents a fundamental change. 3. Compounding effects of better SSA, more satellites, and new operational concepts The changes in the space environment can be seen on this figurative map of low Earth orbit. Fig. 1 shows the LEO environment as a function of altitude. The number of objects found in each 10 km “bin” is plotted on the horizontal axis, while the altitude is plotted vertically. Objects in elliptical orbits are distributed between bins as partial objects proportional to the time spent in each bin. Some notable resident systems are indicated in blue text on the right to provide an altitude reference. The (dotted) red line shows the number of objects in the current catalog tracked by the U.S. Space Surveillance Network (SSN). All the COLA alerts and actions that must be taken by the residents are due to their neighbors in the nearby bins, so the currently visible risk is proportional to the red line. Fig 1 Download : Download full-size image Fig. 1. Objects in LEO orbit by altitude per 10 km altitude bin. Elliptical orbit objects distributed by portion spent in each bin. Some notable existing resident systems are listed on the right. New residents, including some replacement systems, are on the left. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article.) The red line of the current catalog does not represent the complete risk; it indicates the risk we can track and perhaps avoid. A rule of thumb is that the current SSN LEO catalog contains objects about 10 cm or larger. **It is generally accepted that an impact in LEO with an object 1 cm or larger will cause damage likely to be fatal to a satellite's mission**. Therefore, there is a large latent risk from unobserved debris. While **we cannot currently track and catalog much smaller than 10 cm**, experiments have been performed to detect and sample much smaller objects and statistically model the population at this size [3]. The (solid) blue line represents the model of the 1 cm and larger debris that is likely mission-ending, usually called lethal but not trackable. If LEO operators avoid collisions with all the objects in the red line, they are nonetheless inherently accepting the risk from the blue line. This risk is already present. The (dashed) orange line is an estimate of the population at 5 cm and larger and is thus an estimate of what the catalog might conservatively be a few years after the Space Fence, a new radar system being built by the Air Force, comes on line (currently planned for 2019) [4]. Commercial companies offering space surveillance services, such as LeoLabs, ExoAnalytics, Analytic Graphics Inc., Lockheed, and Boeing, might also add to the number of objects currently tracked. Space Policy Directive 3 (SPD-3) [13] specifically seeks to expand the use of commercial SSA services. Existing operators can expect a sharp increase in the number of warnings and alerts they will receive because of the increase in the cataloged population. Almost all the increase will come from newly detected debris [5]. The pace of safety operations for each satellite on orbit will significantly change because of the increase in the catalog from the Space Fence. This effect is compounded because the NewSpace constellations described in Table 1 will drastically change the profile of satellites in LEO. The green bars in Fig. 1 represent the number of objects that will be added to the catalog (red or orange lines) from only the NewSpace large LEO constellations at their operational altitudes. This does not include the rocket stages that launch them, or satellites in the process of being phased into or removed from the operational orbits. Neighbors of one of these new constellations may face a radically different operations environment than their current practices were designed to address. Satellites in these large LEO constellations typically have planned operational lifetimes of 5–10 years. Some companies have proposed to dispose of their satellites using low thrust electric propulsion systems, which would spiral satellites down over a period of months or years from operating altitudes as high as 1500 km through lower orbits where the Hubble Space Telescope, the International Space Station, and other critical LEO satellites operate [6]. Similar propulsive techniques would raise replacement satellites from lower launch injection orbits to higher operational orbits. These disposal and replenishment activities will add thousands of satellites each year transiting through lower altitudes and posing a risk to all resident satellites in those lower orbits. More importantly, failures will occur both among transiting satellites and operational constellations, potentially leaving hundreds more stranded along the transit path. Aerospace studies [7–9] have shown that failed satellites, whether they fail during operations or fail during disposal, can pose as great or even greater risk than the many thousands of operational satellites (Fig. 2). Given the rapid flux in the proposed large LEO constellations (LLC), we created a Future Constellations Model (FCM) with elements that represented the characteristics of the different systems being proposed. In our models, almost all the collisions and the resulting debris from those collisions occur because of failed systems. Most large constellation operators intend to perform active collision avoidance for active systems, whether operational or in some stage of check-out or disposal, but failed satellites are assumed to be incapable of maneuver. Fig. 2 also shows that satellites in the disposal phase can contribute to collisions similarly to satellites in the operational phase. Fig 2 Download : Download full-size image Fig. 2. Collisions during operations and disposal over 10 years for various NewSpace Future Constellation Models (FCMs). 4. A notional illustration of workload **The highest risk to operational satellites comes from the lethal but non-trackable debris** that is depicted in the blue line in Fig. 2. However, **operators perform collision avoidance only on the objects that can be tracked and cataloged**. Advances in tracking and NewSpace launches will both act to increase this workload. A key element of the problem is that an **increase in the LEO population will lead to an increase in close approaches to existing satellites [5], and the potential for accidental collisions**. Conjunction prediction, collision probability (Pc), and maneuver planning for most existing satellite operators is a time- and personnel-intensive operation. Orbit analysts, and propulsion, navigation, and communications systems personnel are involved in evaluating and planning maneuvers over several days and must do so even if the ultimate decision is to “fly through” a close approach. Since most existing systems have small numbers of vehicles and the number of conjunctions any given operator experiences is relatively small, COLA remains a manual process. For systems not designed with automated maneuver planning, a COLA assessment that progresses all the way to a maneuver plan can consume considerable effort, whether or not the maneuver is executed. If a large constellation is deployed next to an existing resident system, the existing system may experience many conjunctions and alerts due to its close proximity of the dense new constellation. A sufficiently large constellation will, in effect, form a “shell” where frequent opportunities for conjunctions will be created. For example, Fig. 3 depicts a fictional scenario where 1225 “New” satellites are distributed in 35 planes in circular orbits at 1000 km altitude, at 98° inclination. These are placed near a hypothetical “Old” six-satellite constellation operating in a nearly circular orbit at the same altitude and 63° inclination. Following a common operations practice, we assume that the Old satellite operators flag a conjunction at Pc> 10−7, start COLA assessment with additional tracking at Pc> 10−6, and plan a COLA maneuver when the Pc> 10−5. A conjunction with Pc > 10−4 would typically be considered a significant risk leading most operators to maneuver. Fig 3 Download : Download full-size image Fig. 3. “New” large LEO constellation at same average altitude as “Old” existing constellation. Currently, the Old system in this example would typically see a warning (Pc > 10−6) a few times a month at this altitude, and of those, a few per year might cross the maneuver threshold. For the operations center, this would be multiplied by the number of satellites in the constellation. When the New system parks nearby, the number of COLA alerts jumps substantially. But the number of alerts depends entirely on the error bubble, (covariance) used. If the typical errors of the public external tracking data and the orbit propagation methods that are widely available (General Perturbations, or GP) are used for both constellations, over a 30-day period we see 129 conjunctions that cross the threshold for COLA assessment (Pc> 10−6), and 53 that cross the maneuver planning threshold (Pc> 10−5) (Fig. 4). This is nearly 2 per day. This could be an enormous workload for a manual process. If a high accuracy catalog (Special Perturbations, or “SP”) and a high-fidelity propagator with its typical covariances is used, the number of conjunctions goes from 129 to a more manageable 10. SP data is maintained by the Air Force, but it is not widely available. It is interesting to note that nine of those 10 crossed the maneuver-planning threshold, and of those, four crossed the Pc> 10−4 where many operators would choose to execute a maneuver. Compared to GP, the SP-quality data resulted in far fewer warnings and flagged four very close conjunctions. The operations center would have been able to concentrate on fewer “false alarms”. We also computed the case where GPS-quality owner-operator data was used for both systems, in which we assumed near-real-time owner-operator position data of very high quality was provided by both operators and used in the collision analysis. In this case, NONE of the conjunctions resulted in a warning and no COLA alerts were generated. The closest approach was 99 m, with a Pc of 3.7 × 10−7 using SP. But because of the quality of the GPS-based position data, this conjunction did not raise an alert because the fully-informed operators could be confident that a collision would not occur. Fig 4 Download : Download full-size image Fig. 4. Number of COLA alerts in 30 days for various qualities of position knowledge when a fictional new system is deployed near an existing one. In the example, an operations center for the Old constellation of six satellites could go from about one COLA assessment a week to nearly one per day per satellite, if only the published satellite catalog is available. If a new constellation operates too close to an existing system, the operator workload may become unreasonable using existing processes. But high accuracy data makes this manageable, and GPS-quality owner-operator data for both systems makes the problem vanish. Since these constellations are likely to be operated by different companies or governments, sharing high-quality position data would likely require an active space traffic management organization. Existing operators will not necessarily have large constellations parked nearby, but they will nonetheless be affected by the new activity. The new large constellations’ satellites typically will have relatively short lifetimes and will need frequent replenishment. The traffic transiting up and down will be substantial, and failures could leave stranded objects at intermediate altitudes, permanently increasing the collision risk. 5. **Conjunction warning overload** NewSpace operators will face a different challenge **due to the vast increase in numbers of satellites**. While there are likely as many operational plans as there are operators, a large constellation must consider close approaches with itself. Even if there are no neighboring systems, self-conjunctions can occur between two members of the same constellation. Depending on the configuration, **a given operator could see hundreds to thousands of self-conjunctions that cross typical warning thresholds each day using current practices.** This could be an issue for a space traffic management (STM) agency, even if it is not an issue for the operator. Aerospace models show that for one possible NewSpace constellation, **more than 500,000 self-conjunctions each year could result that cross the typical Pc > 10−6 warning threshold. If no action were taken, we would expect 2–3 collisions per year.** This is clearly unacceptable. **Thus, current tracking accuracy and processes might produce millions of warnings per year** for NewSpace operators to prevent half a dozen actual collisions. Under current practices **operators would need to sort through an enormous haystack to find the needles, and because a handful of actual collisions will occur, the warnings cannot be ignored.** Note that predictions such as the ones above are based on the current process of using non-cooperative external tracking and observation (i.e., skin tracking), and the resulting covariances. The number of warnings could be drastically reduced by using more accurate owner-operator information, but that is not currently universally done. The Space Data Association provides such a service, but only uses owner-operator data from members. In any case, current practices will need to change to avoid an unreasonable number of warnings. Recognizing this, many NewSpace operators are planning extensive automation to operate their constellations and mitigate the workload of manual COLA assessments, particularly for self-conjunctions. Most are also taking steps to obtain much higher quality position data than external observation permits. While automation may mitigate the COLA assessment workload for new operators, current operators may have to continue their labor-intensive assessments. The interaction between a NewSpace constellation and a nearby existing or a second large NewSpace constellation will create new challenges for operators. 6. **The problem with maneuvers** **Recent years have seen a steady growth in the use of low-thrust propulsion via ion thrusters.** These highly efficient systems have the feature of long, even continuous thrusting. A feature of the automation planned by some of the NewSpace operators is to make extensive use of low-thrust systems for both transit and station-keeping. One approach is to launch into low LEO orbit, transition to the higher LEO operational altitude via low-thrust, and at end-of-life, deorbit the same way. During automated operations, the individual vehicles may autonomously maneuver as needed. Orbit insertion at low LEO altitudes for functional check-out testing has the advantage of allowing early satellite failures to more safely occur in very low, “self-cleaning” orbits. But the slow spirals up to the operational altitude and down for disposal create numerous opportunities for conjunctions with all the resident satellites between the injection altitude and the operational altitude. **Existing catalog and COLA processes have no effective way of dealing with frequent or continuous maneuvers, since they are based on predictions generated days in advance**, with no assumption of maneuvers. **If an existing constellation is operating in proximity to one of these automated constellations, its current COLA process breaks down**. The automated maneuvers may move one vehicle in the constellation out of a conjunction, or it could create a new problematic conjunction. **The existing practices have an inherent lag and data latency, and a small maneuver will at the very least add to the covariance error. The timelines of the current catalog process and automated maneuvers for a large constellation are fundamentally incompatible.**

#### **Kessler Syndrome destroys all satellites and traps us on earth, Ratner 18**

[Paul Ratner, 8-29-2018, "How the Kessler Syndrome can end all space exploration and destroy modern life", Big Think, https://bigthink.com/surprising-science/how-the-kessler-syndrome-can-end-all-space-exploration-and-destroy-modern-life/, date accessed 1-23-2022] //Lex AT

What makes that situation possible is the fact that there are millions of micrometeoroids as well as man-made debris that is already orbiting Earth. The danger posed by even a small fragment that’s traveling at high speeds is easy to see. **As** [**calculated by NASA**](https://www.businessinsider.com/space-junk-kessler-syndrome-chain-reaction-prevention-2018-3)**, a 1-centimeter “paint fleck” traveling at 10km/s (22,000 mph) can cause the same damage as a 550-pound object traveling 60 miles per hour on Earth. If the size of the shard was increased to 10 centimeters, such a projectile would have the force of 7 kilograms of TNT**. Now imagine thousands of such objects flying around at breakneck speeds and crashing into each other. If a chain reaction of exploding space junk did occur, filling the orbital area with such dangerous debris, the space program would indeed be in jeopardy. Travel that goes beyond the LEO, like the planned mission to Mars, would be made more challenging but still conceivably possible. What would, of course, be affected if the Kessler Syndrome’s worst predictions came to pass, are all the services that rely on satellites. Core aspects of our modern life—GPS, television, military and scientific research—all of that would be under threat. NASA experienced a small-scale Kessler Syndrome incident in the 1970s when Delta rockets that were left in orbit started to explode into shrapnel clouds. This inspired Kessler, an astrophysicist, to show that there is a point when the amount of debris in an orbit gets to critical mass. At that point, the collision cascading would start even if no more things are launched into space. And once the chain of explosions begins, it can keep going until the orbital space can no longer be used. In Kessler’s estimate, it would take 30 to 40 years to get to such a threshold. [NASA says](https://www.nasa.gov/centers/wstf/site_tour/remote_hypervelocity_test_laboratory/micrometeoroid_and_orbital_debris.html) that its experts caution that we are already at critical mass in the low-Earth orbit, which is about 560-620 miles (900 to 1,000 kilometers) out. According to NASA estimates, the Earth’s orbit currently has [500,000 pieces of space debris](http://orbitaldebris.jsc.nasa.gov/faqs.html#3) up to 10cm long, over 21,000 pieces of debris longer than 10cm, and more than 100 million pieces of space debris smaller than 1cm. A 2009 incident dubbed the [Cosmos-Iridium collision](http://www.spacesafetymagazine.com/space-debris/kessler-syndrome/iridium-33-cosmos-2251-years-later-learned-then/)featured a space collision between Russian and American communication satellites that provided a preview of potential attractions in the massive debris field it created. The accident resulted in more than 2,000 pieces of relatively large space junk.

#### **Debris triggers nuclear miscalculation—uniquely likely in space, Blatt 20**

[[Talia M. Blatt](https://hir.harvard.edu/author/talia/), May 26th, 2020, "Anti-Satellite Weapons and the Emerging Space Arms Race", Harvard International Review, https://hir.harvard.edu/anti-satellite-weapons-and-the-emerging-space-arms-race/, date accessed 1-23-2022] //Lex AT

Despite their deterrent functions, ASATs are more likely to provoke or exacerbate conflicts than dampen them, especially given the risk they [pose](https://thebulletin.org/2019/06/arms-control-in-outer-space-the-russian-angle-and-a-possible-way-forward/) to early warning satellites. These satellites are a crucial element of US ballistic missile defense, capable of [detecting missiles](https://www.globalsecurity.org/space/world/japan/warning.htm) immediately after launch and tracking their paths. **Suppose a US early warning satellite goes dark, or is shut down**. **Going dark could signal a glitch, but in a world in which other countries have ASATs, it could also signal the beginning of an attack**. Without early warning satellites, the United States is much more susceptible to nuclear missiles. **Given the strategy of counterforcing—**[**targeting**](https://www.belfercenter.org/sites/default/files/files/publication/isec_a_00273_LieberPress.pdf) **nuclear silos rather than populous cities to prevent a nuclear counterattack—the Americans might believe their nuclear weapons are imminently at risk**. **It could be** [**twelve hours**](https://books.google.com/books?id=ET8lDwAAQBAJ&pg=PA1&lpg=PA1&dq=%22Protecting+Space+Assets%22+johnson-freese&source=bl&ots=6Oq0IdeBjw&sig=ACfU3U1G6Hj8QdP4JlCRNxA6i5XplZwHyg&hl=en&sa=X&ved=2ahUKEwj1n-jT2YzpAhUugnIEHUuMCu4Q6AEwA3oECAkQAQ#v=onepage&q=%22Protecting%20Space%20Assets%22%20johnson-freese&f=false) **before the United States regains satellite function, which is too long to wait to put together a nuclear counterattack. The United States, therefore, might move to mobilize a nuclear attack against Russia or China over what might just be a piece of debris shutting off a satellite**. Additionally, accidental warfare, or strategic miscalculation, is uniquely likely in space. It is [much easier](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) to hold an adversary’s space systems in jeopardy with destructive ASATs than it is to [sustainably defend](https://www.cnas.org/publications/commentary/the-us-military-should-not-be-doubling-down-on-space) a system, which is expensive and in some cases not technologically feasible because of limitations on satellite movement. Space is therefore [considered](https://books.google.com/books?id=VyXTDwAAQBAJ&pg=PA339&lpg=PA339&dq=space+offense+dominant&source=bl&ots=Mw0bgJ51qf&sig=ACfU3U3DeZiEHpr9nfszlCbJZIoyyssIpg&hl=en&sa=X&ved=2ahUKEwjrs-WD3IzpAhVulHIEHbL0AE4Q6AEwCXoECAoQAQ#v=onepage&q=space%20offense%20dominant&f=false) offense-dominant; offensive tactics like weapons development are prioritized over defensive measures, such as [improving GPS](https://www.politico.com/story/2018/04/06/outer-space-war-defense-russia-china-463067) or making satellites more resistant to jamming. As a result, countries are left with poorly defended space systems and rely on offensive posturing, which increases the risk that their actions are perceived as aggressive and incentivizes rapid, risky counterattacks because militaries cannot rely on their spaced-based systems after first strikes.

#### **Extinction – nuke war fallout creates Ice Age and mass starvation**

Steven **Starr 15**. “Nuclear War: An Unrecognized Mass Extinction Event Waiting To Happen.” Ratical. March 2015.<https://ratical.org/radiation/NuclearExtinction/StevenStarr022815.html> TG

**A war fought with 21st century** strategic **nuclear weapons would be more than just a great catastrophe in human history. If we allow it to happen, such a war would be a mass extinction event that** [**ends human history**](https://ratical.org/radiation/NuclearExtinction/StarrNuclearWinterOct09.pdf)**. There is a profound difference between extinction and “an unprecedented disaster,” or even “the end of civilization,” because even after such an immense catastrophe, human life would go on.**

But **extinction, by definition, is an event of utter finality, and a nuclear war that could cause human extinction should really be considered as the ultimate criminal act**. It certainly would be the crime to end all crimes.

**The world’s leading climatologists now tell us that nuclear war threatens our continued existence as a species**. Their **studies predict that a large nuclear war, especially one fought with strategic nuclear weapons, would create a post-war environment in which for many years it would be too cold and dark to even grow food**. Their findings make it clear that **not only humans, but most large animals and many other forms of complex life would likely vanish forever in a nuclear darkness** of our own making.

**The environmental consequences of nuclear war would attack the ecological support systems of life at every level. Radioactive fallout produced not only by nuclear bombs, but also by the destruction of nuclear power plants and their spent fuel pools, would poison the biosphere. Millions of tons of smoke would act to** [**destroy Earth’s protective ozone layer**](https://www2.ucar.edu/atmosnews/just-published/3995/nuclear-war-and-ultraviolet-radiation) **and block most sunlight from reaching Earth’s surface, creating Ice Age weather conditions that would last for decades.**

Yet the political and military leaders who control nuclear weapons strictly avoid any direct public discussion of the consequences of nuclear war. They do so by arguing that nuclear weapons are not intended to be used, but only to deter.

Remarkably, the leaders of the Nuclear Weapon States have chosen to ignore the authoritative, long-standing scientific research done by the climatologists, **research** that **predicts virtually any nuclear war, fought with even a fraction of the operational and deployed nuclear arsenals, will leave the Earth essentially uninhabitable.**

#### **Kessler syndrome ensures cascading impacts – turns every impact.**

**Dvorsky 15** George Dvorsky 6-4-2015 “What Would Happen If All Our Satellites Were Suddenly Destroyed?”<https://io9.gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681> (Senior staff reporter at Gizmodo specializing in astronomy, space exploration, SETI, archaeology, bioethics, animal intelligence, human enhancement, and risks posed by AI and other advanced tech.)//Elmer

**Lastly, there’s the** [**Kessler Syndrome**](http://www.spacesafetymagazine.com/space-debris/kessler-syndrome/) **to consider. This scenario was portrayed in the 2013 film Gravity. In the movie, a Russian missile strike on a defunct satellite inadvertently causes a cascading chain reaction that formed an ever-growing cloud of orbiting space debris. Anything in the cloud’s wake — including satellites, space stations, and astronauts — gets annihilated. Disturbingly, the Kessler Syndrome is a very real possibility, and the likelihood of it happening** [**is steadily increasing as more stuff gets thrown into space**](http://io9.com/how-to-clean-up-deadly-space-junk-before-disaster-strik-1443463338)**. Given these grim prospects, it’s fair to ask what might happen to our civilization if any of these things happened. At the risk of gross understatement, the complete loss of our satellite fleet would instigate a tremendous disruption to our current mode of technological existence — disruptions that would be experienced in the short, medium, and long term, and across multiple** [**domains**](https://io9.gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681)**. Compromised Communications Almost immediately we’d notice a dramatic reduction in our ability to communicate, share information, and conduct transactions. “If our communications satellites are lost, then bandwidth is also lost,”** [**Jonathan McDowell**](http://planet4589.org/) **tells io9**. He’s an astrophysicists and Chandra Observatory scientist who works out of the [Harvard-Smithsonian Center for Astrophysics](http://planet4589.org/jcm/cfa-www.harvard.edu). McDowell says that, with telecommunication satellites wiped out, the burden of telecommunications would fall upon undersea cables and ground-based communication systems. But while many forms of communication would disappear in an [instant](https://io9.gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681), others would remain. **All international calls and data traffic would have to be re-routed, placing tremendous pressure on terrestrial and undersea lines. Oversaturation would stretch the capacity of these systems to the limit, preventing many calls from going through. Hundreds of millions of Internet connections would vanish, or be severely overloaded. A similar number of cell phones would be rendered useless. In remote areas, people dependent on satellite for television, Internet, and radio would practically lose all service. “Indeed, a lot of television would suddenly disappear,” says McDowell.** “A sizable portion of TV comes from cable whose companies relay programming from satellites to their hubs.” It’s important to note that we actually have a precedent for a dramatic — albeit brief — disruption in com-sat capability. **Back in 1998,** [**there was a day in which a single satellite failed and all the world’s pagers stopped working**](http://articles.latimes.com/1998/may/21/news/mn-52190)**. Get Out Your Paper Maps We would also lose the Global Positioning System. In the years since its inception, GPS has become ubiquitous, and a surprising number of systems have become reliant on it. “Apart from the fact that everyone has forgotten to navigate without GPS in their cars, many airplanes use GPS as well,” says McDowell**. Though backup systems exist, airlines use GPS to chart the most fuel-efficient and expeditious routes. Without GPS and telecomm-sats, aircraft controllers would have tremendous difficulty communicating with and routing airplanes. Airlines would have to fall back to legacy systems and procedures. Given the sheer volume of airline traffic today, **accidents would be all but guaranteed. Other affected navigation systems would include those aboard cargo vessels, supply-chain management systems, and transportation hubs driven by GPS. But GPS does more than just provide positioning — it also provides for timing.** Ground-based atomic clocks can perform the same function, but GPS is increasingly being used to distribute the universal time standard via satellites. **Within hours of a terminated service, any distributing networks requiring tight synchronization would start to suffer from “clock drift,” leading to serious performance issues and outright service outages. Such disruptions could affect everything from the power grid through to the financial sector. In the report, “**[**A Day Without Space: Economic and National Security Ramifications**](http://marshall.org/wp-content/uploads/2013/08/Day-without-Space-Oct-16-2008.pdf)**,” Ed Morris, the Executive Director of the Office of Space Commerce at the Department of Commerce, writes: If you think it is hard to get work done when your internet connection goes out at the office, imagine losing that plus your cell** [**phone**](https://io9.gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681)**, TV, radio, ATM access,** [**credit cards**](https://io9.gizmodo.com/what-would-happen-if-all-our-satellites-were-suddenly-d-1709006681)**, and possibly even your electricity. [...]** Wireless services, especially those built to [CDMA standard](http://www.protocols.com/pbook/cellular.htm), would fail to hand off calls from one cell to the next, leading to dropped connections. Computer networks would experience slowdowns as data is pushed through finite pipelines at reduced bit rates. The same would be true for major networks for communication and entertainment, since they are all IP-based today and require ultra-precise timing to ensure digital traffic reaches its destination. The lack of effective synch would hit especially hard in banking, where the timing of transactions needs to be recorded. Credit card payments and bank accounts would likely freeze, as billions of dollars could be sucked away from businesses. A financial crash is not out of the question. **The Loss of Military Capability The sudden loss of satellite capability would have a profound effect on the military. The Marshall Institute puts it this way: “Space is a critical enabler to all U.S. warfare domains,” including intelligence, navigation, communications, weather prediction, and warfare. McDowell describes satellite capability as as the “backbone” of the U.S. military. And as 21st century warfare expert** [**Peter W. Singer**](http://www.pwsinger.com/biography.html) **from** [**New America Foundation**](https://www.newamerica.org/) **tells io9, “He who controls the heavens will control what happens in the battles of Earth.” Singer summarized the military consequences of losing satellites in an email to us: Today there are some 1,100 active satellites which act as the nervous system of not just our economy, but also our military. Everything from communications to GPS to intelligence all depend on it. Potential foes have noticed, which is why Russia and China have recently begun testing a new generation of anti-satellite weapons, which in turn has sparked the U.S. military to recently budget $5 billion for various space warfare systems. What would happen if we lost access to space? Well, the battles would, as one U.S. military officer put it, take us back to the “pre digital age.” Our drones, our missiles, even our ground units wouldn’t be able to operate the way we plan. It would force a rewrite of all our assumptions of 21st century high tech war**. We might have a new generation of stealthy battleships...but the loss of space would mean naval battles would in many ways be like the game of Battleship, where the two sides would struggle to even find each other. Moreover, and as McDowell explains to io9, the loss of satellite capability would have a **profound effect on arms control capabilities. Space systems can monitor compliance**; without them, we’d be running blind. “The overarching consideration is that you wouldn’t really know what’s going on,” says McDowell. “Satellites provide for both global and local views of what’s happening. We would be less connected, less informed — and with considerably degraded situational awareness.” Compromised Weather Prediction and Climate Science One great thing satellites have done for us is improve our ability to forecast weather. Predicting a slight chance of cloudiness is all well and good, but some areas, like India, Pakistan, and Bangladesh, are dependent on such systems to predict potentially hazardous monsoons. And in the U.S., the NOAA has estimated that, during a typical hurricane season, weather satellites save as much as $3 billion in lives and property damage. There’s also the effect on science to consider. Much of what we know about climate change comes from satellites. As McDowell explains, the first couple of weeks without satellites wouldn’t make much of a difference. But over a ten-year span, the lack of satellites would preclude our ability to understand and monitor such things as the ozone layer, carbon dioxide levels, and the distribution of polar ice. Ground-based and balloon-driven systems would help, but much of the data we’re currently tracking would suddenly become much spottier. “**We’re quite dependent on satellites for a global view of what’s happening on our planet — and at a time when we really, really need to know what’s happening,” says McDowell. It’s also worth pointing out that, without satellites, we also wouldn’t be able to monitor space weather, such as incoming space storms. Time to Recover With all the satellites gone, both governmental and private interests would work feverishly to restore space-based capabilities. Depending on the nature of the satellite-destroying event, it could take decades or more to get ourselves back to current operational standards**. It would take a particularly long time to recover from a Carrington Event, which would zap many ground-based electronic systems as well. The U.S. military is already thinking along these lines, which is why it’s working on the ability to quickly send up emergency assets, such as small satellites parked in Low Earth Orbit (LEO). Cube satellites are increasingly favored, as an easy-to-launch, affordable, and effective solution — albeit a short-term one. The U.S. Operationally Responsive State Office is currently working on the concept of emergency replenishment and the ability to “rapidly deploy capabilities that are good enough to satisfy warfighter needs across the entire spectrum of operations, from peacetime through conflict.” As for getting full-sized, geostationary satellites back into orbit, that would prove to be a greater challenge. It can take years to built a new satellite, which typically requires a big, costly rocket to get it into space. Lastly, if a Kessler Syndrome wipes out the satellites, that would present an entirely different recovery scenario. According to McDowell, it would take a minimum of 11 years for LEO to clear itself of the debris cloud; any objects below 500 km (310 miles) would eventually fall back to Earth. Thus, we would only be able to start re-seeding LEO in a little over a decade following a Kessler event. Unfortunately, the area above 600 km (372 miles) would remain out of touch for a practically indefinite period of time; objects orbiting at that height tend to stay there for a long, long time. We’d probably lose this band for good — unless we manually removed the debris field, using clean-up satellites or other techniques. It’s worth noting that a single Kessler event could hit the LEO zone or the GEO zone (geosynchronous orbit) but realistically not both; LEO debris could never reach GEO, and vice versa — though a spent rocket in GTO (geosynchronous transfer orbit) or SSTO (supersynchronous transfer orbit) passes through or near both zones and could potentially affect either of them. The spent rockets in GTO do not stay too close to the GEO arc for long due to orbital perturbations, so a GEO Kessler event is very unlikely to be triggered by one of them. Suffice to say, we should probably take the prospect of a Kessler Syndrome more seriously, and be aware of what could happen if we’re no longer able to use these spaces.

#### **Public satellite data is key to biodiversity, Pennisi 21**

[Elizabeth Pennisi, 18 NOV 2021, "Satellites offer new ways to study ecosystems—and maybe even save them", No Publication, https://www.science.org/content/article/satellites-offer-new-ways-study-ecosystems-maybe-even-save-them, date accessed 1-23-2022] //Lex AT

But such studies could only provide a snapshot of one forest at a time. To get the big picture of forests around the world, Cavender-Bares has sought a higher vantage. Now a plant ecologist at the University of Minnesota, Twin Cities, Cavender-Bares has devised ways to translate light measured by spectrometers flown over forests into insights about their health and resilience. She and others have [found this light](https://doi.org/10.1007/978-3-030-33157-3_1), captured from an airplane or satellite, holds clues to intimate details such as photosynthesis levels, the genetic diversity of the trees, and even the microbial inhabitants of the soil they grow in. Such **remote sensing methods are not** only **revolutionizing how scientists such as Cavender-Bares study ecosystems, they’re also poised to become powerful new tools in the fight to protect them**. Over the past year scientists have gathered to revise the most important international treaty aimed at **conservation**, the Convention on Biological Diversity (CBD). With **the loss of plant and animal species accelerating, some researchers say conservation efforts should turn to remote sensing to monitor biodiversity in near–real time across wide swaths of the globe—and help policymakers prioritize the most critical areas**. **Historically, researchers had to venture out to jungles, deserts, and mountaintops to document the flora and fauna.** **But species distributions and abundances are changing faster than ground-based surveys can track, because of climate change, human activities, and other factors.** **Remote sensing offers the possibility of faster, more standardized monitoring across the entire globe.** “In the past decade, there’s been a revolution in the technology available to characterize ecosystems from space,” says David Schimel, a research scientist at NASA’s Jet Propulsion Laboratory. Researchers are just beginning to figure out what remote sensing can and can’t do and how to incorporate it into global conservation efforts. But Schimel and others see great promise for supplementing ground-based measurements with a fuller picture of ecosystems’ health gleaned from aloft. “We want to transform the way biological research is done,” he says. CAVENDER-BARES FIRST learned that reflected or emitted light could help signal forest health during a graduate school visit to the Laboratory for the Use of ­Electromagnetic Radiation (LURE) at Paris-Sud University. In lab studies there almost 40 years ago, plant physiologist Jean-Marie Briantais and colleagues had shown they could measure photosynthetic activity by comparing how leaves fluoresce, or emit certain wavelengths of light, before and after being exposed to flashes of extremely bright white light. As the light displaces electrons inside chlorophyll, the intensity of red and infrared (IR) light emitted from the leaves varies, depending on how healthy the plant is. Later, Ismael Moya, a biophysicist at LURE, developed a sensor that required no extra light source, relying on sunlight instead. Moya went on to demonstrate that fluorescence could be detected from an airplane flying over crops, opening the way to surveying fields’ productivity remotely. “I just became fascinated with what we could learn from the interaction of plants with light and have been for 28 years,” Cavender-Bares says. In that time, researchers have mostly used methods based on reflected light, but fluorescence remains a valuable tool. By now, airplanes, drones, and towers all provide spectroscopic data on vegetation. So does NASA and the U.S. Geological Survey’s series of Landsat satellites, the first of which were launched in the 1970s. Initially, the agencies expected the satellites’ cameras to primarily capture images in visible light, but an experimental spectral sensor on board proved the value of recording more of the electromagnetic spectrum, such as near-IR light, and by 2013 the satellites were monitoring 11 portions of the spectrum. With these “multispectral” data, researchers can monitor how “green” or productive a vegetated landscape is. Spectroscopically detected dips in chlorophyll can also signal a forest that is suffering because of drought or insect invasion—or has been cleared for development.

#### **Biodiversity loss causes extinction, Gallagher 21**

[[Katherine Gallagher](https://inhabitat.com/author/katherinegallagher/), Apr 5, 2021, "“Extinction – The Facts” explores the global extinction crisis", Inhabitat - Green Design, Innovation, Architecture, Green Building | Green design &amp; innovation for a better world, https://inhabitat.com/extinction-the-facts-explores-the-global-extinction-crisis-and-its-consequences/, date accessed 1-19-2022] //Lex AT

Biodiversity loss [Biodiversity](https://inhabitat.com/tag/biodiversity/) refers to the variety of life found on Earth, including plants, animals and micro-organisms. Each of these species and organisms form unique communities and habitats, working together in various ecosystems to maintain balance. The United Nations brought 500 international scientists together in 2019 to investigate the current state of our natural world, only to find that the planet was losing biodiversity at a rate never seen before in the history of humanity. The results were unexpected and unprecedented; there were at least 1 million plant, animal and insect species threatened with extinction at a rate 100 times faster than their natural evolutionary rate. The numbers are nearly split, between about 500,000 insects and 500,000 plants and animals, with populations growing smaller by the day. “Extinction is a natural process,” explained professor Kathy Willis, a plant scientist at the University of Oxford. “Things come, they grow, their populations get huge and then they decline. But it’s the rate of extinction; that’s the problem.” When scientists look at previous groups in fossil records, extinction happens over millions of years. Today, we’re looking at tens of years. Since 1970, vertebrate animals — such as birds and reptiles — have declined by a total of 60%, while large animals have disappeared from three-quarters of their historic ranges. Professor Elizabeth Hadly, a biologist at Stanford University, said one of the most concerning aspects of this decline is that it’s happening simultaneously around the world. “In the Amazon, in Africa, in the [Arctic](https://inhabitat.com/tag/arctic); it’s happening not at one place and not with one group of organisms, but with all biodiversity, everywhere on the planet.” James Mwenda, a conservationist at Ol Pejeta Conservancy in Kenya, is the caretaker for the world’s last two living northern white rhinos, a [species](https://inhabitat.com/tag/species) that once numbered in the thousands throughout Central Africa. “Many people think of extinction being this imaginary tale told by conservationists, but I have lived it. I know what it is,” he said in the documentary. As a caretaker, Mwenda watched the northern white rhino population go from seven in 1990 to just two today, a mother and daughter named Najin and Fatu. A subspecies of the white rhinoceros, the northern white rhino was pushed to the critically endangered list due to hunting and habitat loss. “They’re here because we betrayed them,” he said sorrowfully. “And I think they feel it, this threatening tide of extinction that is pushing on them.” Losing entire portions of the planet’s individual species is tragic enough in itself, but the crisis encompasses much more than that. All of biodiversity is interlocked on a global scale, and the planet needs all parts of it to function properly. Humans are not outside of those ecological systems by any means. For example, a loss in insect species can put [pollination](https://inhabitat.com/tag/pollination/) at risk, which in turn puts food production at risk, affecting both humans and animals alike. Human influence The documentary also examines the ways that humans are driving biodiversity loss. Things like overfishing, deforestation and the illegal wildlife trade are the biggest contributors, but there are also less obvious threats like consumer-driven demand for products like clothes, which can cause pollution in their production. The [illegal wildlife trade](https://inhabitat.com/tag/illegal-wildlife-trade/) has become a multibillion dollar global industry over the last 20 years. Increased income in certain countries like China and Vietnam, where endangered animal parts may be seen as a status symbol or used for medicinal purposes, is one of the largest drivers. Pangolins, for instance, represent the most trafficked animals in the world, and the demand for their scales is directly responsible for their declining numbers. The scale of global [overfishing](https://inhabitat.com/tag/overfishing/) has dramatically increased as well. In some parts of the world, limits on ocean catch aren’t regulated. Scientists have seen declines in larger predator fish as their food supply dwindles due to overfishing, so the impact on marine ecosystems is widespread.

#### **Megaconstellations destroy the ozone, Pultarova 21**

[Tereza Pultarova, June 07, 2021, "Air pollution from reentering megaconstellation satellites could cause ozone hole 2.0", Space, https://www.space.com/starlink-satellite-reentry-ozone-depletion-atmosphere, date accessed 1-23-2022] //Lex AT

**Chemicals released as defunct satellites burn in the atmosphere could damage Earth’s protective ozone layer if plans to build megaconstellations of tens of thousands of satellites, such as SpaceX's** [**Starlink**](https://www.space.com/spacex-starlink-satellites.html)**, go ahead as foreseen, scientists warn**. **Researchers also caution that the poorly understood atmospheric processes triggered by those chemicals could lead to an uncontrolled** [**geoengineering**](https://www.space.com/global-warming-aerosol-reflector-block-sunlight) **experiment, the consequences of which are unknown**. For years, the space community was content with the fact that the amount of material that burns in the atmosphere as a result of Earth's encounters with [meteoroids](https://www.space.com/topics/meteors) far exceeds the mass of defunct satellites meeting the same fate. Even the rise of megaconstellations won't change that. **The problem, however, is in the different chemical composition of natural meteoroids compared to artificial satellites**, according to Aaron Boley, an associate professor of astronomy and astrophysics at the University of British Columbia, Canada. "**We have 54 tonnes (60 tons) of meteoroid material coming in every day**," Boley, one of the authors of a [paper published May 20 in the journal Scientific Reports](https://go.redirectingat.com/?id=92X1588396&xcust=space_us_5124491294381495000&xs=1&url=https%3A%2F%2Fwww.nature.com%2Farticles%2Fs41598-021-89909-7&sref=https%3A%2F%2Fwww.space.com%2Fstarlink-satellite-reentry-ozone-depletion-atmosphere), told Space.com. "**With the first generation of Starlink, we can expect about 2 tonnes (2.2 tons) of dead satellites reentering Earth's atmosphere daily.** But meteoroids are mostly rock, which is made of oxygen, magnesium and silicon. **These satellites are mostly aluminum, which the meteoroids contain only in a very small amount, about 1%."** Uncontrolled geoengineering The scientists realised that megaconstellations have a significant potential to change the chemistry of the upper atmosphere compared to its natural state. But not only that. **The burning of aluminum is known to produce aluminum oxide,** also known as alumina, which can trigger further unexplored side effects. "Alumina reflects light at certain wavelengths and if you dump enough alumina into the atmosphere, you are going to create scattering and eventually change the albedo of the planet," Boley said. Albedo is the measure of the amount of light that is reflected by a material. In fact, [increasing Earth's albedo](https://www.space.com/36431-harvard-researchers-geoengineer-earth-atmosphere.html) by pumping certain types of chemicals into the higher layers of the atmosphere has been proposed as a possible geoengineering solution that could slow down global warming. However, Boley said, the scientific community has rejected such experiments because not enough is known about their possible side effects. "Now it looks like we are going to run this experiment without any oversight or regulation," Boley said. "We don't know what the thresholds are, and how that will change the upper atmosphere." The Cygnus re-supply vehicle, which delivers cargo to the International Space Station, burning up in the atmosphere during its reentry. (Image credit: ESA/Alexander Gerst) **Ozone hole 2.0** The **aluminum from re-entering satellites also has a potential to** [**damage the ozone layer**](https://www.space.com/arctic-ozone-hole-closes.html), a problem well known to humanity, which has been successfully solved by widespread bans on the use of chlorofluorocarbons, chemicals used in the past in aerosol sprays and refrigerators. In their paper, Boley and his colleague Michael Byers cite research by their counterparts from the Aerospace Corporation, a U.S. non-profit research organization, which identified local damage to the planet's ozone layer triggered by the passage of polluting rockets through the atmosphere. "**We know that alumina does deplete ozone just from rocket launches themselves because a lot of solid-fuel rockets use, or have, alumina as a byproduct," Boley said. "That creates these little temporary holes in the stratospheric ozone layer. That's one of the biggest concerns about compositional changes to the atmosphere that spaceflight can cause.**" Advertisement **The ozone layer protects life on Earth from harmful UV radiation.** The depletion of ozone in the stratosphere, the second lowest layer of the atmosphere extending between altitudes of approximately 7 to 40 miles (10 to 60 kilometers), led to an increased risk of **cancer and eye damage for humans on Earth.** Gerhard Drolshagen, of the University of Oldenburg, Germany, who has published papers about the effects of meteoroid material on Earth, told Space.com that reentering satellites usually evaporate at altitudes between 55 and 30 miles (90 and 50 km), just above the ozone-rich stratosphere. However, he added, the particles created as a result of the satellites' burning will eventually sink to the lower layers. **Boley said that as the alumina sinks into the stratosphere, it will cause chemical reactions, which, based on existing knowledge, will likely trigger ozone destruction**. Drolshagen, who wasn't involved in the recent study, agreed that because "**satellites are mostly made of aluminum, the amount of aluminum deposited in the atmosphere will certainly increase**."

#### **Ozone collapse---extinction,**

Susan **Hunt 19**. Biology M.A., “What Will Happen to Life on Earth if Ozone Depletion Continues?“,<http://www.ozonedepletion.co.uk/what-will-happen-life-earth-if-ozone-depletion-continues.html>. Rez

**Most scientists are agreed that without the earth’s ozone layer, we would all cease to exist.** That’s one of the main reasons that global ozone levels are now constantly monitored and worldwide research is taking place into ozone depletion. Land and Water Life Would Suffer **Without the ozone layer’s protection from the sun, people, animals and plant life would be destroyed.** **Even underwater life would not be safe since UV rays can penetrate clear water to a certain depth before being absorbed.** Of course, the actual effect on mankind of less ozone depends on the extent to which it is depleted. Experts believe that for every 1% drop in ozone protection, there is an increase of around 2% in UV-B rays which get through to the planet’s surface. Good News However, research carried out for the United Nations Environmental Programme showed that ozone levels had not fallen further between 2002 and 2005, thanks to initiatives such as the Montreal Protocol. One of the greatest problems with ozone is that we need the “right” amount to maintain life as we know it today. **Too little and life on earth could be wiped out** – but too much and we won’t receive the amount of sunlight that we need. (Some scientists are now concerned that global warming will lead to much higher levels of ozone which could block out too much sun). It is widely known that rates of **skin cancer** are linked to UV-B exposure – which is one of the reasons that it’s so important to use suncream and to make sure that children are protected from the sun. (Latest research suggests that you are more at risk from just two or three instances of extreme sunburn than from prolonged but limited exposure such as sunbathing.) **Increase in Disease** However, increased exposure to the sun’s radiation can also cause blindness and cataracts and, alarmingly, some experts now believe that the amount of protection we receive from vaccinations (for diseases such as measles) could be reduced in people exposed to higher levels of UV-B rays. Depending on the level of exposure to the sun, effects can range from premature ageing to certain kinds of skin cancer. Over the past decade there has been a large increase in the number of people developing skin cancer but this could be attributed to the rise in the popularity of sunbathing over the past quarter-of-a-century rather than simply to reduced ozone levels. **Our Food Chain Many biological systems are damaged by exposure to UV-B and research has shown that its effects are proportional to the time and intensity of exposure and of course, small and delicate organisms are much more vulnerable to damage than larger species, such as humans.** Exposure to higher levels of UV-B can stunt the **growth** and **photosynthesis** of a variety of crops such as maize, rye and sunflowers and can also affect the **reproductive capacity of aquatic life**. Many are already under UV-B stress, and if their exposure is further increased then we could see disruption of some food chains.

#### **Climate change leaves dead satellites stuck in space magnifying debris from megaconstellations, O’Callaghan 21**

[Jonathan O’Callaghan, 5-19-2021, "What if space junk and climate change become the same problem?", WION, https://www.wionews.com/science/what-if-space-junk-and-climate-change-become-the-same-problem-386124, date accessed 1-23-2022] //Lex AT

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 Earth's surface, most objects will naturally decay into the thicker lower atmosphere and burn up in less than 10 years. In the lower atmosphere**, carbon dioxide molecules can rerelease infrared radiation after absorbing it from the sun, which is then 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.” The escape of heat causes the volume of the atmosphere, and thus its density, to decrease. **Since 2000, Brown and his team say the atmosphere at 250 miles has lost 21% 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%.** **For space junk, the implications are stark. More than 2,500 objects larger than 4 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 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. Brown thinks a more probable outcome is somewhere in between, perhaps a 10 times or 20 times increase. The research is “very important work,” said John Emmert, an atmospheric scientist at the US Naval Research Laboratory in Washington, D.C., who has studied atmospheric density loss. However, 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. **The findings may also pose challenges for regulators and satellite operators, especially SpaceX, Amazon and other companies seeking to build megaconstellations of thousands of satellites to beam internet service down to the ground from low Earth orbit**.

#### **Private debris cleanup will fail due to government uncertainty, Erwin 21**

[Sandra Erwin, 10-21-2021, "Analysis: Space Force endorsement not enough to incentivize debris removal industry", SpaceNews, https://spacenews.com/analysis-space-force-endorsement-not-enough-to-incentivize-debris-removal-industry/, date accessed 1-23-2022] //Lex AT

WASHINGTON — U.S. Space Force generals [made headlines](https://spacenews.com/u-s-space-force-would-support-commercial-services-to-remove-orbital-debris/) recently calling for the development of commercial services to clean up orbital debris. These statements convey a sense of urgency about the risk of collisions in space but the government’s indecision about how to manage this problem is delaying private investments and efforts to develop space cleanup businesses, says an industry analyst. In a [white paper](https://www.avascent.com/news-insights/avascent-apogee/building-the-business-case-for-space-debris-removal/) published Oct. 21 by the consulting firm Avascent, analyst Nick Bolger points to comments made last month by [Maj. Gen. DeAnna Burt](https://spacenews.com/space-force-backs-development-of-commercial-orbital-debris-removal-systems/), the vice commander of the Space Force’s Space Operations Command, who said “there is a use case for industry to go after” space debris removal as a business opportunity. From an industry perspective, however, the business case is not quite so clear, Bolger said. “Significant developments need to settle across industry in order to prove out this claim,” he said of Burt’s comments. **With 16,000 satellites expected to be launched from 2021 to 2025, there is wide consensus that space sustainability and safe spaceflight operations are at risk**. **But actions to address the problem are being “challenged by shifting priorities of domestic and international governing agencies**,” Bolger argues. “**Varying opinions of regulatory stakeholders on how to approach debris removal prevents** the U.S. **government from taking action** per se,” he said. **A major obstacle is uncertainty about what agencies should take the lead in specific areas. A case in point is the transition of space traffic management responsibilities from the Defense Department to the Commerce Department which has for years been bogged down in studies and analysis**. The **Space Force says it wants to buy debris removal services, but if space traffic management moves to another agency it’s not clear who would make those buying decisions**. “As far as a business case goes, I believe that **investors may be wary of backing some of these nascent companies without a guarantee of future procurements by the government**,” Bolger said. Another concern is the **lack of standard metrics about collision hazards**, he said. Agencies “self-regulate their space operations, often leveraging varying data sources and risk criteria to determine their need for collision avoidance maneuvers.” There’s been a number of close calls and near-miss collisions in recent years, and yet “governing bodies have shown little indication of taking the lead on deploying space debris removal and remediating technologies in the near future**,**” Bolger noted.

#### **Nuclear deterrence is true absent miscalc,**

**Miller ’16** (Franklin C. Miller – MPA @ Princeton University’s Woodrow Wilson School, principal of The Scowcroft Group, served 22 years in senior positions in the Department of Defense and four additional years on the National Security Council staff as a special assistant to the President, member of the Defense Policy Board and the US Strategic Command Senior Advisory Group, five time recipient of the Defense Distinguished Civilian Service Medal, awarded the Norwegian Royal Order of Merit (Grand Officer) and the French Legion of Honor (Officer). Keith B. Payne – PhD with distinction in International Relational @ USC, Professor and Head of the Graduate Department of Defense and Strategic Studies, Missouri State University, former Deputy Assistant Secretary of Defense for Forces Policy, Chairman of the U.S. Strategic Command’s Senior Advisory Group, Strategy and Policy Panel, editor-in-chief of Comparative Strategy: An International Journal, and co-chair of the U.S. Nuclear Strategy Forum.. “No First-Use Advocacy: Contradictions and Guesswork,” 2016, https://www.realcleardefense.com/articles/2016/09/08/no\_first-use\_advocacy\_\_contradictions\_and\_guesswork\_\_110034.html)

Indeed, **what limited historical evidence is available in this regard suggests that on some occasions US nuclear deterrence has been important to the deterrence of non-nuclear threats**. For example, **the most informed and comprehensive analyses of primary sources indicate that US nuclear deterrence at least contributed to the deterrence of Saddam Hussein’s use of CBW in the 1991 Gulf War**.[v] Kimball and Reif simply dismiss or ignore these analyses when they claim as a sweeping rule that **nuclear deterrence** is unnecessary to deter threats that it, in fact, **appears to have helped deter in 1991**. In addition, it should be noted that **from the founding of the nation state system in 1648 through 1945**, **the major powers in Europe went to war with each other** an average of **seven times per century**; **not even the recent memory of the catastrophic losses of World War I were sufficient to deter World War II**. **After 1945 and the establishment of nuclear deterrence, this history has not repeated itself and the percentage of the world’s population lost to war has declined dramatically**. **This does not** “**prove**” **the effectiveness of nuclear deterrence per se**, **but the association in time at least suggests the powerful limiting effect of nuclear deterrence on humanity’s willingness to go to war.** **The world was long at the nuclear zero** “**mountain top**.” **It most recently looked like World Wars I and II**.