# Framework

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

#### 1. Pleasure is an intrinsic good, that means utilitarianism.

**Moen 16** – (Ole Martin, PhD, Research Fellow in Philosophy @ University of Oslo, "An Argument for Hedonism." Journal of Value Inquiry 50.2 (2016): 267). Modified for glang

Let us start by observing, empirically, that a widely shared judgment about intrinsic value and disvalue is that pleasure is intrinsically valuable and pain is intrinsically disvaluable. On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues. This inclusion makes intuitive sense, moreover, for **there is something undeniably good about the way pleasure feels and something undeniably bad about the way pain feels,** and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have. “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative. 2 The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values. If you tell me that you are heading for the convenience store, I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so, not merely for the sake of going to the convenience store, but for the sake of achieving something further that you deem to be valuable. You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good. 3 As Aristotle observes: “**We never ask what [their]** his **end is in being pleased, because we assume that pleasure is choice worthy in itself.**”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that if something is painful, we have a sufficient explanation of why it is bad. If we are onto something in our everyday reasoning about values, it seems that pleasure and pain are both places where we reach the end of the line in matters of value. Although pleasure and pain thus seem to be good candidates for intrinsic value and disvalue, several objections have been raised against this suggestion: (1) that pleasure and pain have instrumental but not intrinsic value/disvalue; (2) that pleasure and pain gain their value/disvalue derivatively, in virtue of satisfying/frustrating our desires; (3) that there is a subset of pleasures that are not intrinsically valuable (so-called “evil pleasures”) and a subset of pains that are not intrinsically disvaluable (so-called “noble pains”), and (4) that pain asymbolia, masochism, and practices such as wiggling a loose tooth render it implausible that pain is intrinsically disvaluable. I shall argue that these objections fail.

#### 2. Degrees of wrongness—if I break a promise to meet up for lunch, that is not as bad as breaking a promise to take a dying person to the hospital. Only the consequences explain why the second one is much worse. Intuitions outweigh—they’re the foundational basis for any argument and theories that contradict our intuitions are most likely false even if we can’t deductively determine why.

#### 3. Each individual’s intrinsic equal worth mandates that we maximize the lives and liberties of as many as possible.

**4. Extinction comes first under any framework – it has infinite magnitude and life is a prerequisite to moral systems.**

**Thus, I affirm resolved: The appropriation of outer space by private entities is unjust. I will spec anything in CX.**

# Contention 1: Space Debris

**More private actors will be going to space – a new space race has begun.**

**Grady 17** [Monica Grady. Professor of Planetary and Space Sciences at the Open University. “Private companies are launching a new space race –  here's what to expect”. 10-3-2017. Conversation. <https://theconversation.com/private-companies-are-launching-a-new-space-race-heres-what-to-expect-80697>] //ab sp

The space race between the USA and Russia started with a beep from the Sputnik satellite exactly 60 years ago (October 4, 1957) and ended with a [handshake in space](https://theconversation.com/a-handshake-in-space-changed-us-russia-relations-how-long-will-it-last-44846) just 18 years later. The handshake was the start of many decades of international collaboration in space. But over the past decade there has been a huge change.

The space environment is no longer the sole preserve of government agencies. Private companies have entered the exploration domain and are propelling the sector forward more vigorously and swiftly than would be the case if left to governments alone.

It could be argued that a new space race has begun, in which private companies are competing against each other and against government organisations. But this time it is driven by a competition for customers rather than the urge to show dominance by being first to achieve a certain goal. So who are the main players and how will they change the science, technology and politics of space exploration?

Put the phrase “private space exploration” into a search engine and a wealth of links emerges. Several have titles such as: “[Six private companies that could launch humans into space](https://www.space.com/8541-6-private-companies-launch-humans-space.html)”, “[The world’s top 10 most innovative companies in space](https://www.fastcompany.com/3026685/the-worlds-top-10-most-innovative-companies-in-space)” or “10 major players in the private sector space race”. What is immediately apparent is that practically all these companies are based in the US.

There is a big difference between building and launching satellites into low Earth orbit for telecommunications and sending crew and cargo to the International Space Station (ISS) and beyond. Private companies in several nations have been engaged in the satellite market for many years. Their contributions to the development of non-governmental space exploration has helped to lay the trail for entrepreneurs with the vision and resources to develop their own pathways to space.

Today, several companies in the US are looking very specifically at human spaceflight. The three that are perhaps furthest down the road are [SpaceX](http://www.spacex.com/about), [Blue Origin](https://www.blueorigin.com/) and [Virgin Galactic](http://www.virgingalactic.com/). The main goals of all three companies is to reduce the cost of access to space – mainly through reuse of launchers and spacecraft – making space accessible to people who are not specially trained astronauts. One thing these companies have in common is the private passion of their chief executives.

SpaceX was founded in 2002 by Elon Musk, a charismatic entrepreneur, engineer, inventor and investor. The ambition of SpaceX is “to revolutionise space technology, with the ultimate goal of enabling people to live on other planets”. To this end, the company has specialised in the design, manufacture and launch of rockets, providing direct competition to the [United Launch Alliance](http://www.ulalaunch.com/) (between Boeing and Lockheed Martin) that had been the contract holder of choice for launch of NASA and Department of Defense rocket launches.

Its success has been spectacular. Having developed the [Falcon 9](http://www.spacex.com/falcon9) launch vehicle and [Dragon spacecraft](http://www.spacex.com/dragon), it became the first commercial company to dock a spacecraft at the ISS in 2012. The firm now has a regular run there, carrying cargo. But so far, no astronauts. However, the Falcon Heavy is comparable to the Saturn 5 rocket that launched the Apollo astronauts, and SpaceX has designed its vehicle with a view to sending astronauts to the moon by 2018, and to Mars [as early as 2023](https://theconversation.com/elon-musk-releases-details-of-plan-to-colonise-mars-heres-what-a-planetary-expert-thinks-79733).

On September 29, Musk refined his plans, announcing the [BFR project](http://www.bbc.co.uk/news/science-environment-41441877) (which I like to pretend stands for Big F\*\*king Rocket). This would replace the Falcon and Dragon spacecraft – and would not only transport cargo and explorers to the moon and Mars, but could also reduce travel times between cities on Earth. Musk calculates it could take as little as 29 minutes to fly from London to New York.

Whether the company succeeds in sending astronauts to the moon in 2018 remains to be seen. Either way, a lot could be going on then – 2018 is also the year when Blue Origin, founded in 2000 by [Jeff Bezos](https://www.cnbc.com/2017/08/29/inside-jeff-bezos-80-billion-empire.html), the technology and retail entrepreneur behind Amazon, aims to launch people to space. But its ambition is different from that of SpaceX. Blue Origin is focusing on achieving commercially available, sub-orbital human spaceflight – targeting the space tourism industry. The company has developed a vertical launch vehicle ([New Shepard](https://www.blueorigin.com/technology), after the first American astronaut in space, Alan Shepard) that can reach the 100km altitude used to define where “space” begins. The rocket then descends back to Earth, with the engines firing towards the end of the descent, allowing the spacecraft to land vertically. Test flights with no passengers have made successful demonstrations of the technology. The trip to space and back will take about 10 minutes.

But Blue Origin has got some competition from Virgin Galactic, which describes itself as “the world’s first commercial spaceline”. Founded in 2004 by [Richard Branson](https://en.wikipedia.org/wiki/Richard_Branson), also a technology and retail entrepreneur, it plans to carry six passengers at a time into sub-orbital space and give them about six minutes of weightlessness in the course of a two and a half hour flight.

The technology differs from that of SpaceX and Blue Origin in that the launch into space is not from the ground, but from a jet airplane. This mothership flies to an altitude of about 18km (about twice as high as regular aircraft fly) and releases a smaller, rocket-powered spacecraft (SpaceShip Two) which is propelled to an altitude of about 100km. The programme has been delayed by technical difficulties – and then by the tragic loss of pilot [Mike Alsbury](https://www.theguardian.com/science/2014/nov/02/co-pilot-died-virgin-galactic-crash-hailed-renaissance-man), when SpaceShip Two exploded in mid-air during a test flight in 2014. No date is yet set for the first passengers to fly.

There’s also the [Google Lunar XPrize competition](http://lunar.xprize.org/), announced in 2007, with the tagline: “Welcome to the new space race”. The aim of the prize is to launch a robotic mission to the moon, place a lander on the surface and drive 50 metres, sending back high-quality images and video. The competition is still in progress. Five privately funded teams must launch their spacecraft to the moon by the end of 2017.

The changes are taking place against a backdrop of tried and tested international collaboration in space, which took off in earnest at the end of the space race. Throughout the 1980s and 1990s, the US and Russia space programmes complemented each other beautifully – though perhaps not intentionally. Following the cessation of Apollo in 1975, the US space programme focused its efforts on robotic exploration of the solar system.

The Voyager probes gave us [amazing images](https://voyager.jpl.nasa.gov/mission/) of Jupiter, Saturn, Uranus and Neptune. The [Mariner](https://nssdc.gsfc.nasa.gov/planetary/mars/mariner.html) and [Viking missions](https://www.nasa.gov/mission_pages/viking/) to Mars led to Pathfinder, Spirit, Opportunity and Curiosity. Messenger orbited Mercury and Magellan orbited Venus. When New Horizons launched to Pluto in 2006, it was a mission to [visit the last planet left unexplored](https://theconversation.com/new-horizons-finally-gets-up-close-with-pluto-for-15-minutes-44603) in the solar system.

Russia, on the other hand, pursued the goal of human spaceflight, with its incredibly successful [Mir orbiting space station](https://theconversation.com/the-first-space-walk-happened-50-years-ago-and-nearly-ended-in-disaster-38921) and its programme of flights to transfer cosmonauts and cargo backwards and forwards to Mir. Human spaceflight in the US revived with the [Space Shuttle](https://www.nasa.gov/mission_pages/shuttle/main/index.html) and its mission to build and occupy the [International Space Station](https://theconversation.com/five-key-findings-from-15-years-of-the-international-space-station-51540) (ISS). The list of nations that contribute to the ISS continues to grow. The shuttle programme finished in 2011 and, since its successor Orion (built in collaboration with European Space Agency, ESA) is not due to come into service until at least 2023, the international community has been reliant on Russia to keep the ISS fuelled and inhabited.

Today, as well as the US and Russia, there are strong, vibrant and successful space programmes in Europe, Japan, India and China. The European Space Agency was established just two months before the historic handshake of 1975, following many years of independent aeronautical engineering research by individual nations. Similarly, the Chinese, Japanese and Indian space agencies can trace their heritages back to the 1960s. A number of smaller countries including the United Arab Emirates also have ambitious plans.

Of course these countries also compete against each other. There has been widespread speculation that the entry of China into the field was sufficient to introduce a fresh imperative to the US space programme. China has a [well-developed space programme](https://theconversation.com/crashing-space-station-shows-why-china-must-start-to-collaborate-in-orbit-66072) and is currently working towards having a space station in orbit around the Earth by about 2020. A prototype, Tiangong-2, has been in space for almost a year, and was occupied by two astronauts (or “taikonauts”) for a month.

China has also had three successful missions to the moon. And its next mission, Chang’e 5, due to launch towards the end of 2017, [is designed to bring samples from the moon back to Earth](https://theconversation.com/chinas-plan-to-be-first-to-far-side-of-the-moon-could-unveil-inner-lunar-secrets-53253). China also has a declared intent of landing taikonauts on the moon by 2025 – the same time frame in which the US will be testing its new Orion spacecraft in orbit around the moon.

But while there’s an element of competition, the success of the past few decades certainly shows that it is possible to collaborate in space even when tensions rise on the ground. Indeed, space exploration may even act as a buffer zone from international politics, which is surely something worth having. It will be interesting to see how a wider role in space exploration for private companies will affect such international collaborations, especially since so much of the effort is based in the USA.

A benefit of the entry of the private sector into space exploration has been recognition of the high-tech companies that contribute to the growth of the economy as valuable targets for investment. Indeed, [a recent presentation](http://www.goldmansachs.com/our-thinking/podcasts/episodes/05-22-2017-noah-poponak.html?mediaIndex=1&autoPlay=true&cid=sch-pd-google-poponakpodcast64-searchad-201705--&mkwid=8cazG4Ns) at an international investment bank – under a heading of “Space; the next investment frontier” – declared that “investment interest has helped reduce launch costs and spur innovation across related industries, opening up a new chapter in the history of the space economy”.

One of the last engagements of Barack Obama’s presidency was to chair the Whitehouse Frontiers Conference, where space exploration was discussed as much [within the context of US industry](http://www.frontiersconference.org/tracks/interplanetary) as within the drive to explore new worlds. Contributors to the conference included NASA – but overwhelmingly the speakers were from private technology and investment companies.

Perhaps it is cynical to say – but once investment starts to flow, lawyers won’t be far behind. And that is another aspect of the explosion of interest in space commerce and tourism. Laws, statutes and other regulations are necessary to govern the international nature of space exploration. At the moment, the United Nations, through its [Office for Outer Space Affairs](http://www.unoosa.org/), is responsible for promoting international cooperation in the peaceful uses of outer space. It also oversees operation of the [Outer Space Treaty](http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html), which provides a framework for the governance of space and activities that might take place. While the obvious lack of “space police” means that it cannot be practically enforced, it has [never actually been violated](https://theconversation.com/the-outer-space-treaty-has-been-remarkably-successful-but-is-it-fit-for-the-modern-age-71381).

The operation is designed along similar lines to the international treaties that oversee maritime activities and the exploration of Antarctica. This is the closest that there is to international legislation and, since coming into operation in 1967 with the three inaugural signatories of the United States of America, the United Kingdom and the (then) USSR, the treaty has been signed by 106 countries (including China and North Korea). It is necessary to have such controls because although the risks that surround space exploration are high, potential rewards are even higher.

If we look at the way more conventional businesses operate, such as supermarkets, competition drives prices down, and there is little reason to believe that competition between space companies would follow a different model. In which case, greater risks might be taken in order to increase profitability. There is no evidence for this so far – but as the field develops and additional private companies move into space exploration – there will be a higher probability of accident or emergency.

The treaty says that a state launching a probe or satellite is liable to pay compensation for damage when accidents occur. However, the costs of space exploration are astronomical and crippling to poorer countries, making them increasingly depend on commercial launchers. But if a private company launches an object that subsequently causes damage in space, the struggling economy will have to pick up the bill. The treaty [may therefore need to be updated](https://theconversation.com/spacex-explosion-shows-why-we-must-slow-down-private-space-exploration-until-we-rewrite-law-65019) to make private companies more liable. There are also serious issues around the safety of astronauts, who have the legal right to a safe existence when in outer space. But even lawyers aren’t sure whether the law does – or should – extend to private astronauts.

Looking to the future, there will be a need for an expanded version of a Civil Aviation Authority, directing and controlling routes, launches and landings on Earth, and between and on planetary bodies. All the safety and security considerations of air and sea travel will pertain to space travel at a vastly enhanced level, because the costs and risks are so much higher. There will have to be firm and well-understood protocols in the event of a spacecraft crashing, or two spacecraft colliding. Not to mention piracy or the possibility of hijack. All this might sound a little gloomy, taking the dash and exhilaration from space exploration, but it will be a necessary development that opens up the era of space travel for citizens beyond those with deep pockets.

The original space race resulted from the ideas and skills of visionary theoretician engineers including: [Robert H Goddard](https://www.nasa.gov/centers/goddard/about/history/dr_goddard.html), [Wernher von Braun](https://www.nasa.gov/centers/marshall/history/vonbraun/bio.html), [Konstantin E. Tsiolkovsky](https://www.nasa.gov/audience/foreducators/rocketry/home/konstantin-tsiolkovsky.html)… Is it too far a stretch to think that the second space race is propelled by a new generation of entrepreneurs, including Bezos, Branson and Musk? If this is the situation, then I would hope that the main enabling factor in the pursuit of space endeavours is not possession of wealth, but that vision, ingenuity and a wish for the betterment of human are the main driving forces.

**Satellites, rockets, and all launches cause space debris.**

**O'Callaghan 16** [Jonathan O'Callaghan. Space journalist that covers spaceflight, space exploration, and astrophysics. “What is space junk and why is it a problem?”. 5-4-2016. National History Museum. <https://www.nhm.ac.uk/discover/what-is-space-junk-and-why-is-it-a-problem.html>] //ab sp

Since the dawn of the space age in the 1950s, we have launched thousands of rockets and sent even more satellites into orbit. Many are still there, and we face an ever-increasing risk of collision as we launch more.

As long as humans have been exploring space, we've also been creating a bit of a mess. Orbiting our planet are thousands of dead satellites, along with bits of debris from all the rockets we've launched over the years. This could pose an issue one day.

Space junk, or space debris, is any piece of machinery or debris left by humans in space.

It can refer to big objects such as dead satellites that have failed or been left in orbit at the end of their mission. It can also refer to smaller things, like bits of debris or paint flecks that have fallen off a rocket.

Some human-made junk has been left on the Moon, too.

While there are about 2,000 active satellites orbiting Earth at the moment, there are also 3,000 dead ones littering space. What's more, there are around 34,000 pieces of space junk bigger than 10 centimetres in size and millions of smaller pieces that could nonetheless prove disastrous if they hit something else.

All space junk is the result of us launching objects from Earth, and it remains in orbit until it re-enters the atmosphere.

Some objects in lower orbits of a few hundred kilometres can return quickly. They often re-enter the atmosphere after a few years and, for the most part, they'll burn up - so they don't reach the ground. But debris or satellites left at higher altitudes of 36,000 kilometres - where communications and weather satellites are often placed in geostationary orbits - can continue to circle Earth for hundreds or even thousands of years.

Some space junk results from collisions or anti-satellite tests in orbit. When two satellites collide, they can smash apart into thousands of new pieces, creating lots of new debris. This is rare, but several countries including the USA, China and India have used missiles to practice blowing up their own satellites. This creates thousands of new pieces of dangerous debris.

**The amount of space debris is increasing because of private companies like SpaceX – can endanger other spacecrafts and damage the ozone.**

**Gorman 21** [Alice Gorman. Internationally recognized scholar in space archaeology. “Opinion: The growing problem of space junk”. 5-8-2021. CNN. <https://www.cnn.com/2021/05/08/opinions/long-march-5b-space-junk-growing-problem-gorman/index.html>] //ab sp

More than 3 million years ago, members of an unknown hominin species sat on a river bank at the site of Lomekwi, in what is now Kenya, and made a set of stone tools for their daily tasks. Only a trained eye can distinguish the detritus they left behind from naturally broken rocks. In the intervening millennia, human trash has grown in complexity and quantity, introducing novel materials like plastics and metal alloys. What humans discard is fodder for archaeologists, but it's also an environmental problem that is becoming interplanetary.

The Soviet satellite Sputnik 1, which launched on October 4, 1957, was the first human-made object in space. It kick-started the space race and inspired dreams of holidays on the moon and Martian colonies. But the satellite's orbit decayed just three months later, and it burned up as it reentered Earth's atmosphere. It was the first piece of space trash.

Nothing survived of the basketball-sized aluminum sphere with distinctive antennas. That's not likely to be the case for the Long March 5B rocket, which is expected to fall back to Earth this weekend after delivering the Tianhe module of the new Chinese space station to orbit in April. It's one of the largest uncontrolled space objects to fall out of orbit. The rocket uses cryogenic fuel, so its fuel tanks are extremely robust to contain liquid oxygen and hydrogen under high pressure. Based on my observations, fuel system components are the most common rocket element to make it back to Earth.

Most concerns about the uncontrolled reentry of the 22-ton rocket are about how much will remain intact and the potential damage it might inflict on life and property on Earth. But we shouldn't just focus on what makes its way back to the ground. Old satellites, rocket bodies, fragments and particles make up an estimated 9,000 tons of material circling Earth, from a few hundred kilometers to more than 35,000 kilometers in altitude. Most of it is in low-Earth orbit, and pieces of space junk can lose altitude over time and incinerate in the atmosphere. Space junk reenters the atmosphere on a daily basis, although it mostly goes unnoticed because it burns up long before it can hit the ground.

Reentry is considered the most desirable outcome as it removes the space junk from orbit where it can collide with functioning satellites, create more junk, and threaten human life when it comes to crewed spacecraft. But very little work has been done on the effects of reentry on the upper atmosphere and the incineration that happens creates alumina particles that can have an environmental impact.

Studies of fuel exhaust from rocket launches have shown that particles of soot and alumina remain trapped in the stratosphere and can deplete the ozone layer. The ozone layer protects life on Earth from the savage effects of ultraviolet radiation by absorbing it. It's been under threat before, from chlorofluorocarbons or CFCs, which were once commonly used in aerosols and as coolants in refrigerators (the ozone is recovering after international action under the 1987 Montreal Protocols). As the number of rocket launches increases, the more space junk there will be -- and it's unclear what the long-term effects on the atmosphere may be. The quantity of human materials in orbit is only increasing more rapidly with the launch of "megaconstellations" of communication satellites, like Starlink, SpaceX's plan to provide low-cost satellite Internet access. While the effects may be small- scale at the moment, the number of satellites could increase from about 6,000 to 15,000 in the coming decade. This means the number of reentries will also increase.

Scientists are now looking at novel materials for spacecraft manufacture that will not create alumina particles as a by-product of combustion. Silica-based ceramics, like the tiles used for heat shields on the US space shuttles, are durable and light and already widely used in aerospace. A Japanese company has been developing satellites encased in wood with a view to reducing harmful particles. Antennas and electronics are protected from the space environment inside the shell, and no alumina particulates would be created on reentry. It sounds unusual but the creative use of new materials has great potential.

Earth's atmosphere has become a liminal zone that marks a zombie spacecraft's transition to true death. It's now effectively the equivalent of landfill for the space industry. Humans have been discarding junk on Earth for millions of years and the Industrial Revolution brought on a dramatic increase of emissions into the atmosphere. Just like the international waters of the ocean, the atmosphere is considered a global commons. As space activity accelerates over the coming decade, events like the Long March 5b reentry remind us to take nothing on Earth for granted.

#### Private actors are uniquely key to avoid debris cascades – they have lower safety standards and won’t cooperate with others

Yuan 21 [Alda Yuan, Public Health Analyst U.S. Department of Health and Human Services and visiting attorney at the Enivornmental Law Institute with a JD from Yale, 2021, “FILLING THE VACUUM: ADAPTING INTERNATIONAL SPACE LAW TO MEET THE PRESSURES CREATED BY PRIVATE SPACE ENTERPRISES,” Hein Online, https://heinonline.org/HOL/P?h=hein.journals/denilp49&i=27]/Kankee

C. Non-state Actors Introduce Practical Challenges that Endanger the Future of Space Travel If companies are permitted to access space without a proper legal framework or sufficient coordination, the practical risks may doom the project of humanity in outer space for the near future. The opening anecdote dramatized the risks, but the fact that a chain of cascading destruction might preclude the use of whole bands of outer space or make launches impossible is not farfetched. 99 Indeed, it is already happening.0 Because space missions always create debris and there is a correlation between the number of objects orbiting earth and the chances of collision, which thereby creates more debris, even no further activity in space will eventually result in a belt of debris encircling the earth.10 1 This cascade effect, called the Kessler Syndrome, 102 has the potential to speed up astronomically if activities in outer space expand without contingent regulation and mitigation measures.1 1 3 At current rates and in the absence of a catastrophic event, lower earth orbit, in particular, might reach a tipping point within the next ten to fifty years.1 4 If the space debris problem is permitted to reach this tipping point, access to space may well be cut off for the near future because it will be impossible to launch satellites.1 5 Given that we do not have the technology to clean up debris yet, space travel faces an existential threat. In light of this, most space-faring states cooperate, working together to develop guidelines and pool resources to track the debris already orbiting the earth to minimize the chances of a collision.106 Given the high speeds the debris travels at, approximately 10 km/second,107 and the amount of damage even tiny pieces can do, 108 the existing tracking systems are not an absolute fix. At these speeds, a piece of debris weighing a mere two grams can produce an impact force equivalent to a kilogram of TNT.109 More than three hundred thousand pieces of debris greater than one cm in diameter," and therefore capable of causing enormous damage, orbit the earth while the US Space Surveillance Network (SSN) system can only track objects over five cm in diameter." There are millions of fragments smaller than one cm, which are impossible to track and yet can still cause significant damage.11 2 Still, the tracking system is important. In the last twenty years, the International Space Station has carried out several avoidance maneuvers to avoid potential collision with pieces of space debris being tracked by the SSN system.113 Between April of 2011 and April of 2012, the ISS performed four evasive maneuvers." 4 On two additional occasions, the crew fell back to the Soyuz since there was no time to set up an evasive maneuver." 5 This sort of cooperation works given the limited number of actors involved and the aligned interests of the nation-state parties. Commercial space companies do not have the same incentives to cooperate to share data and new technologies. This is why many have called for the creation of a new convention on managing orbital debris. 16 However, escalation of the Kessler Syndrome is not the only problem that might arise by failing to accommodate for the rise of the commercial corporations, so such a convention would not eliminate the threat. For instance, many satellites use nuclear power sources (NPS), which can break up upon reentry." As early as 1978, the Cosmos-954 incident scattered radioactive debris over Canada.118 Other accidents of this type could raise fallout concerns, especially if they occur over more densely populated regions. In an attempt to alleviate this risk and decrease the chances of collisions, various nations have cooperated to design and standardize methods of decommissioning satellites. 119 One strategy is to supply spacecraft with additional fuel and nudge it out of orbit so it will burn up in the atmosphere over the ocean. 120 Another is to push the ailing satellite into a graveyard orbit. 121 These methods require additional research and design and incur additional costs. 12 2 Private companies may not spontaneously take the steps necessary to comport with the common practices of space-faring nations. Thus, the rise of private corporations, while opening up new possibilities, may also threaten space travel itself and the international legal order in which coordination currently occurs. The coordination necessary to prevent and manage the unique problems that arise in space requires a more pragmatic framework. Directly binding private non-state actors benefits the international community because it prevents abusive practices and permits the coordination of efforts that make space safer. However, it will also benefit the private sector by providing companies with a background legal structure, neutral dispute resolution, and common guidelines to even the playing field. More importantly, if companies not subject to regulation and oversight are permitted to operate in outer space, disasters cannot be effectively prevented. In that case, space exploration and the benefits stemming from it might be closed off for all. III. SPACE IS A GLOBAL COMMONS UNDER CUSTOMARY INTERNATIONAL LAW

#### By definition, mega-constellations make debris cascades inevitable

Siegel 20 [Ethan Siegel, astrophysicist, author, and science communicator, who professes physics and astronomy at various colleges, 2-19-2020, "Flaremageddon: How Satellite Mega-Constellations Could Create A New Natural Disaster," Forbes, https://www.forbes.com/sites/startswithabang/2020/02/19/flaremageddon-how-satellite-mega-constellations-could-create-a-new-natural-disaster/#51403cf049cf]/Kankee

Over the next few years, the night sky and the volume of space that surrounds the Earth are both poised to become very different than they've been for all of human history. As of 2019, humanity had launched an estimated total of between 8,000 and 9,000 satellites, with approximately 2,000 of them still active. As SpaceX's Starlink, OneWeb, Amazon's Project Kuiper, Telesat and other companies prepare to provide worldwide 5G coverage from space (more than 300 new satellites have gone up for these purposes [in the last 9 months](https://www.forbes.com/sites/jonathanocallaghan/2020/02/17/spacex-launches-fifth-starlink-mission-and-takes-its-total-number-of-satellites-up-to-300/)), humanity is beginning to enter the era of satellite mega-constellations. While media coverage has largely mentioned only one detrimental effect so far — [the damage that these satellites are already causing to astronomy](https://www.forbes.com/sites/startswithabang/2020/01/30/dangers-to-astronomy-intensify-with-spacexs-latest-starlink-launch/) — there's a second consequence that could be even more disastrous: Kessler syndrome. With tens or even hundreds of thousands of satellites in orbit, a single collision could trigger a chain reaction. With the realities of solar flares and the technological needs of mega-constellations, this new type of natural disaster may be unavoidable. The idea of [Kessler syndrome](https://en.wikipedia.org/wiki/Kessler_syndrome) is a simple one: if there are too many satellites around Earth, an unfortunate collision between any two of them could create enough debris that another collision becomes inevitable. Although [there is not widespread agreement](http://physics.ucsc.edu/cosmo/Mountbat.PDF) on when that point will be reached, it's widely recognized that greater numbers of larger satellites greatly increases this risk. With Starlink alone proposing a total of 42,000 satellites in three different orbital shells and many other companies sure to soon follow suit, the danger of Kessler syndrome is poised to increase by orders of magnitude over the 2020s. In prior years, satellites were launched into orbits that were tracked and knowable, but with occasional collisions occurring due to inactive satellites whose orbits were decaying due to atmospheric drag. With mega-constellations, however, artificial intelligence will be entering the picture, and this poses a tremendous danger. With so many objects in orbit at the same altitude, artificial intelligence will be required in order to constantly leverage the on-board thrusters to accomplish three main goals: to ensure the correct, continuous spacing of the satellites to provide the necessary internet coverage, to compensate for the drag of Earth's atmosphere, and to perform any necessary boosts or orbital alterations to avoid collisions with other satellites. This last point is absolutely critical. Any two orbits at the same altitude always have two points where they will cross, and satellite drift would make a collision inevitable. Only by having the satellites correct their own courses in real-time can they ensure a collision-free scenario. But this plan comes along with a catastrophic scenario: what if the satellites are rendered non-responsive by some event? If constant orbital corrections are needed in order to avoid collisions with other satellites, the worst thing that could happen would be a scenario that ~~paralyzed~~ [stopped] the satellites and made them unable to respond to not only the artificial intelligence, but to a manual command. This is not some science-fiction horror scenario, but something as inevitable as the Sun itself: space weather. Events like solar flares, coronal mass ejections, and even the plain old solar wind all send charged particles away from the Sun. When they happen to get sent on their way towards planet Earth, our surface is protected by our world's magnetic field and our atmosphere. The danger to humans or any biological organism is essentially zero, with the largest effect that commonly occurs being a spectacular looking auroral display. But in space, even in low-Earth orbit, the atmosphere offers no protection, and the magnetic field offers no guarantee of redirecting these particles away from satellites. [According to NOAA](https://www.swpc.noaa.gov/impacts): Solar Energetic Particles (energetic protons) can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes in during Solar Radiation Storms. Right now, the Sun is in the quietest part of its periodic solar cycle. On timescales of 11 years, the number of sunspots — which correlates directly with the odds of flaring activity and coronal mass ejections — goes from essentially zero (a quiet Sun) to solar maximum and back to zero again. Right now, in 2020, we're just leaving the last solar minimum, with the next maximum anticipated to occur in 2024 or 2025 and every 11 years after that. There's a tremendous danger to satellites whenever this type of space weather impacts them. If these energetic protons cause any type of electrical failure in these satellites, they will be unable to adjust their course via artificial intelligence or any other means. If they cannot adjust their course, the question of any two of these satellites colliding becomes a game of Russian roulette, where there are likely to be a series of near-misses before the inevitable — an in-space collision between two of them — occurs. The worst-case scenario, and this scenario gets worse with every new large satellite that goes up (and every communications satellite is "large" by this metric), is that each collision increases both the likelihood and frequency of in-orbit collisions. In short order, potentially just weeks or months, the region around Earth will become a debris field, with a significant percent of existing satellites destroyed. At present, every space disaster, [including collisions](https://en.wikipedia.org/wiki/2009_satellite_collision) and failed missions that have exploded or malfunctioned in various ways, means that there are perhaps a few hundred thousand pieces of space debris the size of your fingernail or larger. These are already hazardous to our existing satellites, with one of them colliding with the International Space Station just a few years ago, cracking a window. But with hundreds of thousands of large satellites, a single collision could set off a catastrophic chain reaction like we've never seen. In short order, the number of pieces of space debris could rise into the tens of millions, impacting satellites in both low-Earth orbit and medium-Earth orbit. The first company whose satellites cause such a disaster would likely impact every other one, to say nothing of military and scientific satellites presently in orbit. Not only will satellite technology become an impossibility for decades or even many generations, but routine space launches will become an enormous gamble. The greatest danger that the Sun poses to Earth today is a large-scale coronal mass ejection, which — if it heads right for us with the wrong magnetic field orientation — could lead to a wide-scale electrical catastrophe that could knock out power grids all over the Earth, starting fires and causing trillions of dollar in damage to our infrastructure.

**Accidental collision escalates conflict and becomes war.**

**Beauchamp 14** [Zack Beauchamp. Senior correspondent at Vox who covers foreign policy. “How space trash could start a nuclear war”. 4-21-2014. Vox. <https://www.vox.com/2014/4/21/5625246/space-war-china-north-korea-iran>] //ab sp

Panic in the skies! "The threats to U.S. space assets are significant and growing," according to a new report from the Council on Foreign Relations, which warns that there's a real chance of breaching conflict's final frontier.

This isn't idle fearmongering. The report makes a not-crazy case that efforts by China and other powers to limit America's total military dominance of space could accidentally destroy an American satellite, inadvertently convincing the US that war was coming and prompting retaliation on Earth. Its author, Micah Zenko, has [**made a name**](http://www.theamericanconservative.com/articles/the-anti-warrior/) for himself in report-after-report downplaying the threat to the United States from China, terrorists, and, really, [**most things**](http://blogs.cfr.org/zenko/2012/02/23/clear-and-present-safety-the-united-states-is-more-secure-than-washington-thinks/). So that fact that Zenko is this [**concerned about space**](http://www.cfr.org/space/dangerous-space-incidents/p32790?sp_mid=45655631&sp_rid=emFjay5iZWF1Y2hhbXBAZ21haWwuY29tS0) should tell you something.

The basic dynamic is simple: the US controls space and its opponents don't. Of all the money spent on space by all countries combined, America [**spends**](http://www.cfr.org/space/dangerous-space-incidents/p32790?sp_mid=45655631&sp_rid=emFjay5iZWF1Y2hhbXBAZ21haWwuY29tS0) 75 percent. It also owns 43 percent of all satellites. It uses that huge satellite network for, among other things, all sorts of military spying and coordination purposes. At one point, the Bush Administration [**mused openly**](http://www.armscontrol.org/act/2004_11/Krepon) about putting actual weapons pointed at Earth in space.

Countries who might hypothetically fight a war with the United States hate that space dominance, which gives the US a real strategic edge. Some have [**developed**](http://www.stimson.org/images/uploads/Anti-satellite_Weapons.pdf) anti-satellite (ASAT) weapons, usually missiles that shoot into space. Zenko thinks ASAT weapons are really dangerous, particularly those owned by China, North Korea, and Iran. The threat comes from both deliberate use and the risk of a misunderstanding that could spiral out of control.

The "greatest threat to international space security," in Zenko's view, is a Chinese accident. China is [**seriously investing**](http://america.aljazeera.com/articles/2014/4/16/china-s-presidentxiurgesgreatermilitaryuseofspace.html) in ASAT weaponry, which it has tested by blowing up old satellites in low earth orbit, one of the places place where satellites live. These explosions create debris, which can travel tens of thousands of miles per hour and shred up other satellites and spacecraft.

If debris from a Chinese test destroys a US military satellite, the US could mistake it as a preemptive strike against its space capabilities — some of which are [**designed**](http://www.pbs.org/wgbh/nova/military/nuclear-false-alarms.html) to detect nuclear missile launches. If the US thinks China is trying to take out its ability to detect a nuclear launch, things could get very bad, very quickly.

Accidents aren't the only concern. Zenko also worries about intentional space attacks, either during peacetime or a crisis. Here, Iran and North Korea are probably bigger threats, though their ASAT capabilities are far from proven.

North Korea has a pattern of crazy military moves designed to extort concessions from South Korea and the West; it could extend that behavior to space. Iran, according to Zenko, "already views space as a legitimate arena in which to contest US military power." He worries that Iran might fire missiles into space "during a major crisis, especially if it believes war is imminent — an assessment that could have self-fulfilling consequences."

But even if none of these scenarios for war are likely, preparing and testing for space war is intrinsically dangerous. Space debris don't discriminate between military and non-military satellites; the more ASAT testing there is, the more hazardous space travel becomes for everyone. As satellites become increasingly important to the economy and scientific research, even preparation for space war becomes deadly.

So what is to be done? Zenko has a 12-point list of recommendations, including investing in debris cleanup capabilities and a US declaration unilaterally forswearing ASAT weapons. These aren't pipe dreams: the US and Soviet Union negotiated the Outer Space Treaty, which [**banned**](http://www.state.gov/t/isn/5181.htm) "orbital weapons of mass destruction," in 1967.

If the US and Soviet Union could do that at the height of the Cold War, the prospects for space arms control are real. Until then, though, it's worth lifting up our eyes and looking towards the heavens.

**Space war is likely.**

**Roberts 17.** Thomas González Roberts - space security researcher at the Center for Strategic and International Studies, and host of [Moonstruck](https://www.moonstruckpodcast.com/), a podcast about humans in space. [“Why We Should Be Worried about a War in Space.” The Atlantic. December 15, 2017. <https://www.theatlantic.com/science/archive/2017/12/why-we-should-be-worried-about-a-war-in-space/548507/>]

One hundred miles above the Earth’s surface, orbiting the planet at thousands of miles per hour, the six people aboard the International Space Station enjoy a perfect isolation from the chaos of earthly conflict. Outer space has never been a military battleground. But that may not last forever. The debate in Congress over whether to create a Space Corps comes at a time when governments around the world are engaged in a bigger international struggle over how militaries should operate in space. Fundamental changes are already underway. No longer confined to the fiction shelf, space warfare is likely on the horizon.

While agreements for how to operate in other international domains, like the open sea, airspace, and even cyberspace, have already been established, the major space powers—the United States, Russia, and China—have not agreed upon a rulebook outlining what constitutes bad behavior in space. It’s presumed that International Humanitarian Law would apply in outer space—protecting the civilian astronauts aboard the International Space Station—but it’s unclear whether damaging civilian satellites or the space environment itself is covered under the agreement. With only a limited history of dangerous behavior to study, and few, outdated guidelines in place, a war in space would be a war with potentially more consequences, but far fewer rules, than one on Earth.

**Space war would go nuclear.**

**Skibba 20** [Ramin Skibba. Writer bas in San Diego that has written for *Undark, New Scientist, and Nature*. “The Ripple Effects of a Space Skirmish”. 7-12-2020. Atlantic. <https://www.theatlantic.com/technology/archive/2020/07/space-warfare-unregulated/614059/>]

A number of countries are developing new military technologies for space. France, for instance, is working on laser beams that could dazzle another country’s satellite, preventing it from taking pictures of classified targets. North Korea is studying how to jam radio frequency signals sent to or from a satellite, and Iran is devising cyberattacks that could interfere with satellite systems. Meanwhile, the big three space heavyweights—the U.S., Russia, and China—are already capable of all three approaches, according to the SWF report.

The big three have also begun to master what the reports call “rendezvous and proximity operations,” which involve using satellites as surveillance devices or weapons. A satellite could maneuver within miles of a rival’s classified satellite, snap photos of equipment, and transmit the pictures down to Earth. Or a satellite could sidle up to another and spray its counterpart’s lenses or cover its solar panels, cutting off power and rendering it useless. Russia may be ahead with this technology, having already [launched](https://time.com/5779315/russian-spacecraft-spy-satellite-space-force/) a series of small “inspector satellites,” as the Russian government calls them. Last fall, according to Gen. John “Jay” Raymond, chief of space operations for the U.S. Space Force, one crept near a U.S. spy satellite, which he called a “[potentially threatening behavior](https://www.businessinsider.com/russian-spacecraft-trailing-us-spy-satellite-space-force-commander-report-2020-2).”

So far, there are relatively few international policies or norms about what’s allowed in modern-day space and what’s not. The SWF report notes that an incident or misunderstanding could escalate tensions if it’s perceived as an attack.

The lack of guidance has left room for a range of activities. Weeden said that in December 2019, the Trump administration signaled its intention to strengthen the United States’ space weaponry and protect its spacecraft from possible attacks by Russia and China by transforming the Air Force Space Command into the U.S. Space Force. That shift “brought a full-time operational focus to the space domain, which was a needed change,” wrote Lieutenant Colonel Christina Hoggatt, a Space Force spokesperson, in a statement to **Undark**. With these forces, the Defense Department seeks to “strengthen deterrence” and improve capabilities to “defend our vital assets in space,” she wrote. This emphasis, Burbach said, likely means that the U.S. military will focus on making satellites more resilient to attack, rather than developing offensive weapons

Compared with the U.S., smaller space powers have fewer satellites and therefore less to lose, the U.N.’s Porras said. He argues that tense regional relationships could be particularly unpredictable. For example, he said, if North Korean leaders found themselves in a standoff with South Korea and the U.S., they might launch and detonate a nuclear weapon in space; its dangerous radiation would disable most satellites.

The U.N. and other international groups—including SWF and the Outer Space Institute, a global research organization based in British Columbia—are working to avoid such scenarios. Weeden said that as long as countries don’t launch destructive space weapons near other countries’ spacecraft, conduct overtly provocative tests, or disable critical satellites, peaceful space activities should continue. For now, he points out, countries have only tested missiles on their own defunct satellites, and exercises against other nations’ spacecraft have remained nondestructive.

Existing international laws offer little guidance for modern military technology in space. While these rules—including the Partial Nuclear Test Ban Treaty of 1963 and the U.N.’s Outer Space Treaty of 1967—prohibit weapons of mass destruction in space, they don’t explicitly limit other kinds of space weapons, tests, or military space forces.

Weeden points out that space diplomats could create new guidelines by developing something like the Incidents at Sea agreement, which the U.S. and the Soviet Union signed during the Cold War to maintain safe distances between ships and avoid maneuvers in heavy traffic. But until similar rules involving space weaponry are hammered out, he said, unexpected satellite tests will inevitably fuel speculation and paranoia.

“Any time you have militaries operating near each other without a lot of transparency or clarity,” he added, “you always have the opportunity for misperceptions that could lead to something very bad.”

#### Nuclear war causes extinction via nuclear winter.

**Starr ’17** (Steven; director of the University of Missouri’s Clinical Laboratory Science Program, senior scientist at the Physicians for Social Responsibility, Associate member of the Nuclear Age Peace Foundation, expert in the environmental consequences of nuclear war; 1/9/17; “Turning a Blind Eye Towards Armageddon — U.S. Leaders Reject Nuclear Winter Studies”; <https://fas.org/2017/01/turning-a-blind-eye-towards-armageddon-u-s-leaders-reject-nuclear-winter-studies/>; Federation of American Scientists; accessed 11/24/18; TV)

The detonation of an atomic bomb with this explosive power will **instantly ignite fires** over a surface area of three to five square miles. In the recent studies, the scientists calculated that the **blast**, **fire**, and **radiation** from a war fought with 100 atomic bombs could produce **direct fatalities** comparable to all of those worldwide in World War II, or to those once estimated for a “**counterforce**” nuclear war between the superpowers. However, the **long-term environmental effects** of the war could significantly disrupt the global weather for at least a decade, which would likely result in a **vast global famine**. The scientists predicted that **nuclear firestorms** in the burning cities would cause at least five million tons of **black carbon smoke** to quickly rise above cloud level into the stratosphere, where it could not be rained out. The smoke would circle the Earth in **less than two weeks** and would form a global **stratospheric smoke layer** that would remain for more than a decade. The smoke would absorb warming sunlight, which would **heat the smoke** to temperatures near the boiling point of water, producing ozone losses of 20 to **50 percent** over populated areas. This would almost double the amount of UV-B reaching the most populated regions of the mid-latitudes, and it would create UV-B indices unprecedented in human history. In North America and Central Europe, the time required to get a painful sunburn at mid-day in June could decrease to as little as six minutes for fair-skinned individuals. As the smoke layer blocked warming sunlight from reaching the Earth’s surface, it would produce the **coldest** average **surface temperatures** in the last 1,000 years. The scientists calculated that global food production would decrease by 20 to **40 percent** during a five-year period following such a war. Medical experts have predicted that the shortening of growing seasons and corresponding decreases in agricultural production could cause up to **two billion** people to perish from **famine**. The climatologists also investigated the effects of a nuclear war fought with the vastly more powerful **modern thermonuclear weapons** possessed by the United States, Russia, China, France, and England. Some of the thermonuclear weapons constructed during the 1950s and 1960s were **1,000 times more powerful** than an atomic bomb. During the last 30 years, the average size of thermonuclear or “strategic” nuclear weapons has decreased. Yet today, each of the approximately 3,540 strategic weapons deployed by the United States and Russia is seven to **80 times** more powerful than the atomic bombs modeled in the India-Pakistan study. The smallest strategic nuclear weapon has an explosive power of **100,000 tons of TNT**, compared to an atomic bomb with an average explosive power of 15,000 tons of TNT. Strategic nuclear weapons produce much larger nuclear firestorms than do atomic bombs. For example, a standard Russian 800-kiloton warhead, on an average day, will ignite fires covering a surface area of 90 to 152 square miles. A war fought with hundreds or thousands of U.S. and Russian strategic nuclear weapons would ignite **immense** nuclear **firestorms** covering land surface areas of many thousands or **tens of thousands** of square miles. The scientists calculated that these fires would produce up to **180 million tons** of black carbon soot and smoke, which would form a dense, **global stratospheric smoke layer**. The smoke would remain in the stratosphere for 10 to **20 years**, and it would block as much as **70 percent** of sunlight from reaching the surface of the Northern Hemisphere and 35 percent from the Southern Hemisphere. So much sunlight would be blocked by the smoke that the noonday sun would resemble a full moon at midnight. Under such conditions, it would only require a matter of days or weeks for daily minimum temperatures to fall **below freezing** in the largest agricultural areas of the Northern Hemisphere, where freezing temperatures would occur every day for a period of between one to more than two years. Average surface temperatures would become colder than those experienced 18,000 years ago at the height of the last Ice Age, and the prolonged cold would cause average rainfall to decrease by up to 90%. Growing seasons would be completely eliminated for more than a decade; it would be **too cold and dark** to grow food crops, which would **doom the** majority of the **human population**. NUCLEAR WINTER IN BRIEF The profound cold and darkness following nuclear war became known as nuclear winter and was first predicted in 1983 by a group of NASA scientists led by Carl Sagan. During the mid-1980s, a large body of research was done by such groups as the Scientific Committee on Problems of the Environment (SCOPE), the World Meteorological Organization, and the U.S. National Research Council of the U.S. National Academy of Sciences; their work essentially supported the initial findings of the 1983 studies. The idea of nuclear winter, published and supported by prominent scientists, generated extensive public alarm and put political pressure on the United States and Soviet Union to reverse a runaway nuclear arms race, which, by 1986, had created a global nuclear arsenal of more than 65,000 nuclear weapons. Unfortunately, this created a backlash among many powerful military and industrial interests, who undertook an extensive media campaign to brand nuclear winter as “bad science” and the scientists who discovered it as “irresponsible.” Critics used various uncertainties in the studies and the first climate models (which are primitive by today’s standards) as a basis to criticize and reject the concept of nuclear winter. In 1986, the Council on Foreign Relations published an article by scientists from the National Center for Atmospheric Research, who predicted drops in global cooling about half as large as those first predicted by the 1983 studies and described this as a “nuclear autumn.”

**Launches and debris damage the ozone in multiple ways.**

**O'Donnel 18** [Josy O'Donnel. Founder of the conservation institue. “What Happens to the "Space Junk" that Falls back to Earth?”. 12-10-2018. Our Planet. <https://ourplnt.com/space-junk-earth/>] //ab sp

The ozone is a protective layer in the upper atmosphere that shields the Earth from the ultraviolet rays of the Sun. Environmentalists have long warned of the harmful effects to this layer by earth-based human activity. Some modern scientists believe that space activity may also adversely affect the ozone layer.

This destruction can happen in three ways. First, when rockets are launched, their emissions in the upper atmosphere may be harmful to the ozone. Though more research is needed, some experts like engineer [Martin Ross](https://www.scientificamerican.com/article/how-much-air-pollution-is-produced-by-rockets/) of the Aerospace Corporation theorize that the rocket exhaust particles remain in the upper reaches of the atmosphere, increasing the temperature through their absorption of solar energy.

Second, as the orbits of human-made debris degrade, and they re-enter the earth’s atmosphere, a shock wave occurs in the upper reaches of the layer of ozone. This physical stress on the area can be damaging to the protective buffer. Researchers have discovered that the impact of objects entering the atmosphere at high speed can produce [nitric oxide](https://books.google.com/books?id=Gpwgm022ltMC&pg=PA284&lpg=PA284&dq=shock+waves+create+nitrous+oxide+in+stratosphere&source=bl&ots=YM-MlE1TWQ&sig=CeRXiNYPpEvUEvJYovnl6Bo6DyE&hl=en&sa=X&ved=2ahUKEwiJqJvG9I7fAhUFLqwKHXuOBjs4ChDoATAFegQIABAB#v=onepage&q=shock%20waves%20create%20nitrous%20oxide%20in%20stratosphere&f=false) during the rapid cooling that follows the splitting of oxygen and nitrogen. Nitric oxide is very destructive to the ozone layer.

Finally, though most of the debris that re-enters the earth’s atmosphere is vaporized due to the build-up of intense heat, the chemical residue of this material can also react with the ozone and deplete it.

Some scientists fear that erosion of the ozone layer may cause global climate change. They predict that these altered weather patterns could transform fertile farmland into deserts and threaten human life on the planet. Thus, the environmental effect of space debris upon the ozone is of great concern to these experts.

**Rocket launches severely damage the environment and are increasing fast.**

**Miraux 21** [Loïs Miraux, Project Lead for Environmental Impact @ The Space Generation Advisory Council, “Environmental limits to the space sector's growth,” Science of the Total Environment, https://www.sciencedirect.com/science/article/abs/pii/S0048969721059404]

The amount of material emitted by the ≈100 rockets launched every year is about 40,000 tons, only 0.01% of the fuel burned by the global aviation sector (Ross and Sheaffer, 2014). However, during their ascent from ground to orbit, they release gases and particles in all the layers of the atmosphere. This is a unique characteristic because rockets are the only anthropogenic source of pollution in the middle and upper atmosphere, that is, above 15 km where airlines emissions stop (Ross and Sheaffer, 2014). Emissions into the troposphere, the lower layer of the atmosphere, are not important besides transient, local pollution. However, emissions in the stratosphere, the layer above the troposphere, are more concerning for two main reasons. First, the stratosphere being dynamically isolated from the troposphere, emissions components of hundreds of launches accumulate for several years (Ross and Vedda, 2018). Then, the stratosphere is the home of the ozone layer, a region of high concentration of ozone at 15–35 km altitudes, absorbing most of the Sun's harmful ultraviolet radiation and thereby protecting living organisms on the ground (Fig. 4). In addition to these particularities, the magnitude of the effects of rocket emissions on the atmosphere varies significantly depending on the type of propellant combination used. Liquid Rocket Engines (LREs) use propellants in the liquid form, such as liquid oxygen combined with liquid hydrogen as a fuel (e.g. Ariane 5) or kerosene (e.g. SpaceX's Falcon 9). This allows thrust variability, but LREs are often coupled with Solid RocketMotors (SRMs) (e.g. Ariane 5 boosters) because they grant higher energy density for lift-off. SRMs typically use a combination of solid aluminium fuel with ammonium perchlorate as an oxidizer. A third type of rocket is being used more recently: Hybrid Rocket Engines (HREs), using a liquid oxidizer and a solid fuel, often a hydrocarbon. They grant high safety, making them popular for space tourism applications (e.g. Virgin Galactic's SpaceShipTwo). Although there are still many uncertainties and serious knowledge gaps on the effect of launch emissions on the atmosphere (Ross and Vedda, 2018), estimates of orders of magnitude are available in the literature. 3.2. Stratospheric ozone depletion During the lifecycle of complete space missions, the launch event has been reported to contribute to almost 100% of the ozone depletion potential (Chanoine, 2017).Ozone is destructed mostly by highly reactive radicals(oxides of chlorine, nitrogen, bromine, and hydrogen), with a single molecule able to destroy up to 100,000 ozone molecules(Ross et al., 2009). Ozone depletion from SRMs particles has historically been the main concern with the first studies carried out by Cicerone (Cicerone, 1974). LREs exhausts contain less reactive chemicals and particles and are, therefore, responsible for ozone loss one order of magnitude smaller than SRMs (Ross et al., 2009). The ozone loss caused by the global launch fleet has been estimated to be greater than 0.01% and less than 0.1%, with regional effects reaching several percent and with complete destruction in the surroundings of exhaust plumes (Voigt et al., 2013). This is to be compared to the ozone loss caused by ozone-depleting substances(ODSs) banned by the Montreal Protocol of about 3% (Ross and Vedda, 2018) (of the total amount of ozone). As a consequence, the present-day contribution of rockets to ozone loss is small. It represents a few percent of the total anthropogenic contribution to ozone depletion, about the same relative impact that global aviation has on climate radiative forcing (Ross et al., 2009). However, the trends discussed in the introduction make an increase of launch emissions by a factor of 10 credible, which would make the contribution of rockets comparable to that of banned ODSs, as Ross and Vedda warn (Ross and Vedda, 2018). A 2009 study highlighted the limitations to the growth of the space sector due to ozone depletion. It showed that, considering launch rates required by proposed space systems at that time (i.e. to be implemented in the future), global ozone loss could become significant, even using only LREs (Ross et al., 2009). Moreover, a 2010 study found that a fleet of 1000 launches per year of hydrocarbonbased HREs typically used for space tourism would cause ozone loss up to 6% in polar regions(Ross et al., 2010). With the anticipated growth of the space sector, the contribution of rockets to ozone depletion will inevitably increase in the future. As the study warns, there will be a growing risk of regulation of rocket exhaust compounds in the name of ozone protection. Important data uncertainties combined with the fact that the Montreal Protocol lacks adapted metrics to tackle rocket emissions effectively make this risk even more important (Ross and Vedda, 2018). If left unregulated, by 2050 rocket emissions could deplete ozone more than ODSs ever did (Ross et al., 2009; ScienceDaily, 2009). 3.3. Contribution to climate change While the effect of rocket emissions on the ozone layer has been studied for several decades, the concern about their impact on climate is more recent. Available life cycle assessment studies of space missions are scarce and often do not account for emissions occurring during the launch event, or only partially, due to lack of data availability and modeling complexity (Maury et al., 2020a; Chanoine, 2017; Harris and Landis, 2019; Gallice andMaury, 2018). Yet, launch emissions are likely to be the most important contributor to the impact on climate change of the global space sector. Rocket exhausts contain greenhouse gases(e.g. CO2, H2O) but also particles (e.g. alumina, black carbon). The amount of greenhouse gases emitted by rockets is dwarfed by that of other industrial sectors, making their contribution to the problem insignificant. However, the effect of particles is much more concerning. Black carbon particles accumulate in the stratosphere and absorb a fraction of sunlight, resulting in a warming of the stratosphere. Because some rockets can emit about 10,000 times more black carbon than modern turbine engines(Ross and Sheaffer, 2014), the amount of black carbon emitted by rockets in the stratosphere in 2018 was comparable to that emitted by global aviation (Ross and Toohey, 2019). On the other hand, alumina features amore complex behavior by both reflecting incoming radiation into space and absorbing upwelling radiation from the Earth. This also results in a warming of the stratosphere (Ross and Sheaffer, 2014). At the same time, the reduction in solar flux caused by this accumulation of particles in the stratosphere leads to a cooling of the lower atmosphere (the troposphere) and the ground (Fig. 4). In 2014, Ross and Sheaffer estimated that rocket emissions globally contributed to warm the stratosphere by about 16 ± 8 mW/m2, with relative contributions of 70% for black carbon, 28% for alumina, 2% for H2O, and ≈0% for CO2 (Ross and Sheaffer, 2014). This means that hydrocarbon-based rockets emitting black carbon (e.g. kerosene-fueled LREs, or most HREs) and SRMs emitting alumina are responsible for most of rockets' climate impact. As a consequence, studies considering only CO2 emissions to assess the contribution of rockets to climate change underestimate it by several orders of magnitude. Although this value is only an approximation subjected to uncertainties and requiring further confirmation, the study makes an interesting comparison with the contribution of global aviation to radiative forcing,which in 2014 was bigger only by a factor of 4, in absolute values (Ross and Sheaffer, 2014). This means that the magnitude of cooling of the troposphere from rockets could be comparable to the magnitude of warming from aviation. However, this should not be interpreted too quickly as something “positive”. Stratospheric injection of particles has long been discussed by climate scientists as a method of solar geoengineering to counteract the warming of greenhouse gases. But this has always been very controversial and encountered strong opposition. Rocket emissions compounds act as geoengineering agents and, therefore, launchers are already beginning this process in an uncontrolled manner, while black carbon geoengineering — on a much larger scale — has been found to present potentially catastrophic side effects (Kravitz et al., 2012). In addition, since rocket emissions are not distributed homogeneously around the globe, they can cool the troposphere in certain regions but still warm it in other regions because of the complex response of the global climate (Ross et al., 2010). Consequently, Ross and Vedda warn that it is uncertain how policymakers would respond to significant growth in launch activities in a context of growing concerns on climate intervention. Once again, this risk is further increased by the lack of confidence in current radiative forcing estimations (Ross and Vedda, 2018). The projects mentioned in the introduction could fuel such an important growth. For instance, after a decade of launches at a rate of 1000 per year, the fleet of hydrocarbon-based HREs(typical for space tourism applications) would create the same radiative forcing as global aviation (Ross et al., 2010), and could rise polar surface temperatures as much as 1 °C. Interestingly, Ross and Sheaffer estimated that the carbon footprint of a passenger in a typical sub-orbital space tourism flight is comparable to that of a passenger travelling thousands of times in aircraft between Los Angeles and London (Ross and Sheaffer, 2014). This illustrates that, in addition to possible future policy implications, the potential climate impact of space tourism raises important issues related to climate justice in the age of “flygskam”. But space tourism is not the only emerging market with high launch rate potential. The Chinese solar power plant is planned to require more than 100 launches of Long March 9, a heavy rocket fueled by kerosene (SpaceNews, 2021). Current plans of SpaceX for Earth-toEarth travel and Mars colonization will be based on its Starship that relies on a liquid oxygen/liquid methane combination expected to be less harmful than kerosene, but this maybe largely offset by the significant associated increase in launch rate.

#### Warming causes extinction

#### Xu and Ramanathan 17

Yangyang Xu 17, Assistant Professor of Atmospheric Sciences at Texas A&M University; and Veerabhadran Ramanathan, Distinguished Professor of Atmospheric and Climate Sciences at the Scripps Institution of Oceanography, University of California, San Diego, 9/26/17, “Well below 2 °C: Mitigation strategies for avoiding dangerous to catastrophic climate changes,” Proceedings of the National Academy of Sciences of the United States of America, Vol. 114, No. 39, p. 10315-10323

We are proposing the following extension to the DAI risk categorization: warming greater than 1.5 °C as “dangerous”; warming greater than 3 °C as “catastrophic?”; and warming in excess of 5 °C as “unknown??,” with the understanding that changes of this magnitude, not experienced in the last 20+ million years, pose existential threats to a majority of the population. The question mark denotes the subjective nature of our deduction and the fact that catastrophe can strike at even lower warming levels. The justifications for the proposed extension to risk categorization are given below. From the IPCC burning embers diagram and from the language of the Paris Agreement, we infer that the DAI begins at warming greater than 1.5 °C. Our criteria for extending the risk category beyond DAI include the potential risks of climate change to the physical climate system, the ecosystem, human health, and species extinction. Let us first consider the category of catastrophic (3 to 5 °C warming). The first major concern is the issue of tipping points. Several studies (48, 49) have concluded that 3 to 5 °C global warming is likely to be the threshold for tipping points such as the collapse of the western Antarctic ice sheet, shutdown of deep water circulation in the North Atlantic, dieback of Amazon rainforests as well as boreal forests, and collapse of the West African monsoon, among others. While natural scientists refer to these as abrupt and irreversible climate changes, economists refer to them as catastrophic events (49). Warming of such magnitudes also has catastrophic human health effects. Many recent studies (50, 51) have focused on the direct influence of extreme events such as heat waves on public health by evaluating exposure to heat stress and hyperthermia. It has been estimated that the likelihood of extreme events (defined as 3-sigma events), including heat waves, has increased 10-fold in the recent decades (52). Human beings are extremely sensitive to heat stress. For example, the 2013 European heat wave led to about 70,000 premature mortalities (53). The major finding of a recent study (51) is that, currently, about 13.6% of land area with a population of 30.6% is exposed to deadly heat. The authors of that study defined deadly heat as exceeding a threshold of temperature as well as humidity. The thresholds were determined from numerous heat wave events and data for mortalities attributed to heat waves. According to this study, a 2 °C warming would double the land area subject to deadly heat and expose 48% of the population. A 4 °C warming by 2100 would subject 47% of the land area and almost 74% of the world population to deadly heat, which could pose existential risks to humans and mammals alike unless massive adaptation measures are implemented, such as providing air conditioning to the entire population or a massive relocation of most of the population to safer climates. Climate risks can vary markedly depending on the socioeconomic status and culture of the population, and so we must take up the question of “dangerous to whom?” (54). Our discussion in this study is focused more on people and not on the ecosystem, and even with this limited scope, there are multitudes of categories of people. We will focus on the poorest 3 billion people living mostly in tropical rural areas, who are still relying on 18th-century technologies for meeting basic needs such as cooking and heating. Their contribution to CO2 pollution is roughly 5% compared with the 50% contribution by the wealthiest 1 billion (55). This bottom 3 billion population comprises mostly subsistent farmers, whose livelihood will be severely impacted, if not destroyed, with a one- to five-year megadrought, heat waves, or heavy floods; for those among the bottom 3 billion of the world’s population who are living in coastal areas, a 1- to 2-m rise in sea level (likely with a warming in excess of 3 °C) poses existential threat if they do not relocate or migrate. It has been estimated that several hundred million people would be subject to famine with warming in excess of 4 °C (54). However, there has essentially been no discussion on warming beyond 5 °C. Climate change-induced species extinction is one major concern with warming of such large magnitudes (>5 °C). The current rate of loss of species is ∼1,000-fold the historical rate, due largely to habitat destruction. At this rate, about 25% of species are in danger of extinction in the coming decades (56). Global warming of 6 °C or more (accompanied by increase in ocean acidity due to increased CO2) can act as a major force multiplier and expose as much as 90% of species to the dangers of extinction (57). The bodily harms combined with climate change-forced species destruction, biodiversity loss, and threats to water and food security, as summarized recently (58), motivated us to categorize warming beyond 5 °C as unknown??, implying the possibility of existential threats. Fig. 2 displays these three risk categorizations (vertical dashed lines).

# Contention 2: Competition

**The amount of money to be made in space breeds competition – which makes war unavoidable.**

**Funnell 18** [Antony Funnell. Walkley award winning journalist. “Why war in space is 'inevitable'”. 08-23-2018. ABC News. <https://www.abc.net.au/news/2018-08-24/conflict-in-space-is-inevitable-expert-warns/10146314>] //ab sp

A leading Australian space law expert has warned conflict over space assets is "inevitable", and more needs to be done now to avert the potential for hostility. Professor Melissa de Zwart, the Dean of Law at the University of Adelaide, says growing commercial interest in the mining of precious minerals on asteroids and planets has heightened the danger. "I think you have to be a realist about that," she said. "Where you have resources, where you have competition for those resources, where you have investment of money in the extraction of those resources ... there will be an expectation of security around that investment." While full-scale mining is yet to be tried, there is significant international interest. Japanese aerospace agency Jaxa has already successfully landed a robotic craft on an asteroid and taken samples. [It currently has another probe hovering over an asteroid named Ryugu](https://www.abc.net.au/news/science/2018-06-27/hayabusa-2-spacecraft-is-about-to-arrive-at-ryugu/9911680). Two American companies — Deep Space Industries and Planetary Resources — are thought to be the leaders in the field, but in May this year a UK firm called Asteroid Mining Corporation also entered the race. "Those corporations will be looking to the nation-state to say, well, are you going to protect our investment in this business?" Professor de Zwart said. The US Government and American firms continue to play a dominant role in more traditional space technology development and deployment. SpaceX, for example, is a major private supplier of rockets, while the US Air Force currently coordinates international satellite traffic, providing advanced warnings about potentially dangerous space debris.But the number of players is rapidly increasing.

The OECD's Space Forum says more than 80 countries now have some form of space program, mostly concentrated on rockets, satellites and satellite-related services and technology. They estimate the global industry is worth somewhere around $US400 billion and growing quickly. And that figure could skyrocket if, and when, asteroid mining kicks off. Eric Stallmer, the president of the US-based Commercial Spaceflight Federation, a consortium of 85 space-related organisations and businesses, believes that moment is fast approaching. "I think we are looking at a five to 10-year timetable for developing that technology. It makes for an exciting time," he said. Despite the growing international competition, US officials continue to refer to space in hegemonic terms. Earlier this month US Vice-President Mike Pence spoke of outer space as the "next great American frontier", while Defence Secretary James Mattis described it as one of America's "vital national interests". He then went on to warn that it was becoming a "contested war fighting domain". "We have got to adapt to that reality," he said. "It's on par with the air, land, sea and cyberspace domains in terms of it being contested. And we've got to be able to compete, to deter and to win." America's new Space Force — a separate and independent arm of the military — is set to be established by 2020. 'I've always said that rich guys seem to like rockets': Trump is launching a space military There's also to be a Space Command and a Space Development Agency, tasked with the creation of future space technologies. America's main space-related military activity — such as the deployment of defence satellites — is currently undertaken by the US Air Force on behalf of other branches of the military. Much of that role is likely to be given over to this new entity, but exactly how the Space Force will operate, and the broad nature of its brief, still remains a mystery. The Pentagon has been tasked with finalising the details, which will then be put before Congress for final approval. The Woomera Manual is expected to be completed in 2020, the same year America's new Space Force is due to come into effect.

**Competition leads to the militarization of space.**

**Salin 01** [Patrick A. Salin. “Privatization and militarization in the space business environment.” 02-2001. Elsevier Space Policy. [https://sci-hub.se/https://www.sciencedirect.com/science/article/abs/pii/S0265964600000503](https://sci-hub.se/https:/www.sciencedirect.com/science/article/abs/pii/S0265964600000503)] //ab sp

We may consider that outer space should no longer be considered as a sanctuary safe from military operations as of 19 June 1999. On that day, a US Theater HighAltitude Area Defense (THAAD) rocket hit a target missile outside the Earth's atmosphere. Outer space is now undergoing a militarization process that is developing within a totally new framework, that of the privatization of space ventures and projects. The bipolar Cold War stage has been removed and gone is the threatening vision of nuclear warfare via all sorts of Earth-based and spaceborne weapons. Yet the big industrial concerns that manufactured the weapons of the Cold War have simply converted themselves and regrouped into mammoth civilian manufacturers, deploying constellations of civilian assets in outer space.2 Instead of procuring the much-criticized US Strategic Defense Initiative (SDI), they now produce dual-use goods that can be used in an undi!erentiated manner for both civilian and military objectives [3,4]3. The borderlines between civilian and military high technology goods that prevailed only a few years ago have become meaningless and technical parameters that quali"ed equipment as being military, less than "ve years ago, are now useless, commercial entities being able to sell these, once forbidden tools, as plain commercial gadgets.4 The confusion between the US Department of Commerce and the US Department of State over determining what is (or should be) subject to authorization and what is not is illustrative of this situation. Yet, thanks to the loopholes and inconsistencies of the international treaties on outer space, we may soon end up with exactly the same result as during the Cold War \* Hollywood's Star Wars, live! We are slowly discovering that the militarization process of outer space seems to be a given, thanks to increasing competition within the space business environment. And, as privatization has accelerated during the last decade, we can clearly see an acceleration of the militarization process of outer space. This has become apparent  through two main observations: (1) private space corporations are, more than ever, vanguards of national interests; and (2) commercial competition is another way for nations to impose their influence in space (and world) affairs. In the end, what is at stake here is the fragile equilibrium between world peace and tensions, now transported into outer space.

**Militarization of space leads to space war.**

**Gilliard 19** [Alexandra Gilliard. “What are the Consequences of Militarizing Outer Space?”. 6-10-2019. Global Security Review. <https://globalsecurityreview.com/consequences-militarization-space/>] //ab sp

The consequences of weapons testing and aggression in space could span generations, and current technological advances only increase the urgency for policymakers to pursue a limitations treaty. As it stands, there are three major ramifications of a potential arms race in space:

As both financial and technological barriers to the space services industry have decreased, the number of governmental and private investors with assets in space has inevitably increased. There is now an abundance of satellites in space owned by multiple states and corporations. These satellites are used to not only coordinate military actions, but to perform more mundane tasks, like obtaining weather reports, or managing on-ground communications, and navigation.

Should states begin weapons testing in space, debris could cloud the orbit and make positioning new satellites impossible, disrupting our current way of life. More pressing, however, is that if a country’s satellites are successfully destroyed by an enemy state, military capabilities can be severely hindered or destroyed, leaving the country vulnerable to attack and unable to coordinate its military forces on the ground.

Diminished future use of near space

Whether caused by weapons testing or actual aggression, the subsequent proliferation of debris around the planet would damage our future ability to access space. Not only would debris act as shrapnel to preexisting assets in space, but it would also become much more difficult to launch satellites or rockets, hindering scientific research, space exploration, and commercial operations.

From the past fifty-odd years of activity in space alone, the debris left behind in Earth’s orbital field has already become hazardous to spacecraft — a main reason why the U.S. and the Soviet Union did not continue with ASAT testing during the Cold War. If greater pollution were to occur, space itself could be become unusable, resulting in the collapse of the global economic system, air travel, and various communications.

Power imbalances and proliferation on the ground

Only so many states currently have access to space—which means any militarization be by the few, while other states would be left to fend for themselves. This would establish a clear power imbalance that could breed distrust among nations, resulting in a more insecure world and a veritable power keg primed for war. Additionally, deterrence measures taken by states with access to space would escalate, attempting to build up weapons caches not dissimilar to the nuclear weapons stockpiling activities of the Cold War.

In any arms race, it is inevitable that more advanced weaponry is created. Yet, this does not only pose a risk to assets in space. Should a terrestrial war break out, this weaponry may eventually be deployed on the ground, and space-faring states would be able to capitalize on the power imbalance by using these new developments against states that have not yet broken into the space industry or developed equally-advanced weaponry.

Into the Future

The militarization of space would inevitably increase the chances of war, and also threaten the industries that rely on space to carry out their daily operations. Without treaties and resolutions to regulate and limit armament in space, the international community risks facing extreme consequences. Furthermore, with the history of U.S. disinterest in UN efforts to regulate space, the implementation of a meaningful, multilateral agreement for arms control in space is unlikely.

Ultimately, the international community will need to regulate actions, militarization, and the possibility of eventual armament in space sooner rather than later in order to reduce the threat of major war, economic destruction, and global insecurity.