#### I affirm the resolution, the appropriation of outer space by private entities is unjust.

My Value in today’s debate is justice because the word unjust in the resolution implies this deb

VC: utiliatarianism – can

1. Encompasses other value criterias – rules and preventing structural violence all have impacts and utilirainism subsumes them
2. Allows for the best weighing

Observation 1:

#### Appropriation of outer space is the exercise of exclusive control.

**Justin Trapp from UIUC law 13** (TIMOTHY JUSTIN TRAPP, JD Candidate @ UIUC Law, ‘13, TAKING UP SPACE BY ANY OTHER MEANS: COMING TO TERMS WITH THE NONAPPROPRIATION ARTICLE OF THE OUTER SPACE TREATY UNIVERSITY OF ILLINOIS LAW REVIEW [Vol. 2013 No. 4])//DebateDrills AY

The issues presented in relation to the nonappropriation article of the Outer Space Treaty should be clear.214 The ITU has, quite blatantly, created something akin to “property interests in outer space.”215 It allows nations to exclude others from their orbital slots, even when the nation is not currently using that slot.216 This is directly in line with at least one definition of outer-space appropriation.217 [\*\*Start Footnote 217\*\*Id. at 236 (“**Appropriation of outer space**, **therefore, is ‘the exercise of exclusive control or exclusive use’ with a sense of permanence, which limits other nations’ access to it.**”) (quoting Milton L. Smith, The Role of the ITU in the Development of Space Law, 17 ANNALS AIR & SPACE L. 157, 165 (1992)). \*\*End Footnote 217\*\*]The ITU even allows nations with unused slots to devise them to other entities, creating a market for the property rights set up by this regulation.218 In some aspects, this seems to effect exactly what those signatory nations of the Bogotá Declaration were trying to accomplish, albeit through different means.219 Though the legitimacy of such a regime may be questionable, it remains in effect, showing that it is at least tolerable under the edict of the nonappropriation article of the Outer Space Treaty.220 There must, therefore, be something about the ITU that differentiates it from something like the Bogotá Declaration.221 The most immediate difference is the character of the body promulgating the regulation. The Bogotá Declaration is an agreement between eight countries claiming rights to all space above them.222 The ITU’s regulations are promulgated under the auspices of the U.N.223 While the Bogotá Declaration is an international agreement, it is still a very limited cooperation.224 The ITU, through the U.N., comprises the largest possible cooperation of international actors, giving it an international character as opposed to simply a multinational character.225 Furthermore, the allocation of orbital slots by the ITU is a response to the limited character of geostationary orbits.226 While the Bogotá Declaration was probably promulgated in response to a few nations’ fears that they may be excluded from the space arena,227 **the allocation system of the ITU is a measure to make sure that the GEO resource is efficiently managed for the use of all mankind**

**This means that only space activties, like mining and megacontellations whicch destroy access to other people constitue appropiation, not small research satelitles or anything launched into space for the sake of being launched**

## Contention 1: Collisions (135)

**Private companies are set to mine in space – new tech and profit motives make space lucrative**

**Gilbert 21,** (Alex Gilbert is a complex systems researcher and PhD student in Space Resources at the Colorado School of Mines, “Mining in Space is Coming”), 4-26-21, Milken Institute Review, https://www.milkenreview.org/articles/mining-in-space-is-coming // MNHS NL

Space exploration is back. after decades of disappointment, a combination of better technology, falling costs and a rush of competitive energy from the private sector has put space travel front and center. indeed, many analysts (even some with their feet on the ground) believe that commercial developments in the space industry may be on the cusp of starting the largest resource rush in history: mining on the Moon, Mars and asteroids. While this may sound fantastical, some baby steps toward the goal have already been taken. Last year, NASA awarded contracts to four companies to extract small amounts of lunar regolith by 2024, effectively beginning the [era of commercial space mining](https://payneinstitute.mines.edu/wp-content/uploads/sites/149/2020/09/Payne-Institute-Commentary-The-Era-of-Commercial-Space-Mining-Begins.pdf). Whether this proves to be the dawn of a gigantic adjunct to mining on earth — and more immediately, a key to unlocking cost-effective space travel — will turn on the answers to a host of questions ranging from what resources can be efficiently. As every fan of science fiction knows, the resources of the solar system appear virtually unlimited compared to those on Earth. There are whole other planets, dozens of moons, thousands of massive asteroids and millions of small ones that doubtless contain humungous quantities of materials that are scarce and very valuable (back on Earth). Visionaries including Jeff Bezos [imagine heavy industry moving to space](https://www.fastcompany.com/90347364/jeff-bezos-wants-to-save-earth-by-moving-industry-to-space) and Earth becoming a residential area. However, as entrepreneurs look to harness the riches beyond the atmosphere, access to space resources remains tangled in the realities of economics and governance. Start with the fact that space belongs to no country, complicating traditional methods of resource allocation, property rights and trade. With limited demand for materials in space itself and the need for huge amounts of energy to return materials to Earth, creating a viable industry will turn on major advances in technology, finance and business models. That said, there’s no grass growing under potential pioneers’ feet. Potential economic, scientific and even security benefits underlie an emerging geopolitical competition to pursue space mining. The United States is rapidly emerging as a front-runner, in part due to its ambitious Artemis Program to lead a multinational consortium back to the Moon. But it is also a leader in creating a legal infrastructure for mineral exploitation. The United States has adopted the world’s first spaceresources law, recognizing the property rights of private companies and individuals to materials gathered in space. However, the United States is hardly alone. Luxembourg and the United Arab Emirates (you read those right) are racing to codify space-resources laws of their own, hoping to attract investment to their entrepot nations with business-friendly legal frameworks. China reportedly views space-resource development as a national priority, part of a strategy to challenge U.S. economic and security primacy in space. Meanwhile, Russia, Japan, India and the European Space Agency all harbor space-mining ambitions of their own. Governing these emerging interests is an outdated treaty framework from the Cold War. Sooner rather than later, we’ll need [new agreements](https://issues.org/new-policies-needed-to-advance-space-mining/) to facilitate private investment and ensure international cooperation.

Back up for a moment. For the record, space is already being heavily exploited, because space resources include non-material assets such as orbital locations and abundant sunlight that enable satellites to provide services to Earth. Indeed, satellite-based telecommunications and global positioning systems have become indispensable infrastructure underpinning the modern economy. Mining space for materials, of course, is another matter. In the past several decades, planetary science has confirmed what has long been suspected: celestial bodies are potential sources for dozens of natural materials that, in the right time and place, are incredibly valuabl**e**. Of these, water may be the most attractive in the near-term, because — with assistance from solar energy or nuclear fission — H2O can be split into hydrogen and oxygen to make rocket propellant, facilitating in-space refueling. So-called “rare earth” metals are also potential targets of asteroid miners intending to service Earth markets. Consisting of 17 elements, including lanthanum, neodymium, and yttrium, these critical materials (most of which are today mined in China at great environmental cost) are required for electronics. **And they loom as bottlenecks in making the transition from fossil fuels to renewables backed up by battery storage**. The Moon is a prime space mining target. Boosted by NASA’s mining solicitation, it is likely the first location for commercial mining. The Moon has several advantages. It is relatively close, requiring a journey of only several days by rocket and creating communication lags of only a couple seconds — a delay small enough to allow remote operation of robots from Earth. Its low gravity implies that relatively little energy expenditure will be needed to deliver mined resources to Earth orbit. The Moon may look parched — and by comparison to Earth, it is. But recent probes have confirmed substantial amounts of water ice lurking in [permanently shadowed craters](http://lroc.sese.asu.edu/posts/1105) at the lunar poles. Further, it seems that solar winds have implanted significant deposits of helium-3 (a light stable isotope of helium) across the equatorial regions of the Moon. Helium-3 is a potential fuel source for second and third-generation fusion reactors that one hopes will be in service later in the century. The isotope is packed with energy (admittedly hard to unleash in a controlled manner) that might augment sunlight as a source of clean, safe energy on Earth or to power fast spaceships in this century. Between its water and helium-3 deposits, the Moon could be the resource stepping-stone for further solar system exploration. Asteroids are another near-term [mining target](https://foreignpolicy.com/2016/04/28/the-asteroid-miners-guide-to-the-galaxy-space-race-mining-asteroids-planetary-research-deep-space-industries/). There are all sorts of space rocks hurtling through the solar system, with varying amounts of water, rare earth metals and other materials on board. The asteroid belt between the orbits of Mars and Jupiter contains most of them, many of which are greater than a kilometer in diameter. Although the potential water and mineral wealth of the asteroid belt is vast, the long distance from Earth and requisite travel times and energy consumption rule them out as targets in the near term. The prospects for space mining are being driven by technological advances across the space industry. The rise of reusable rocket components and the now-widespread use of off-the-shelf parts are lowering both launch and operations costs. Once limited to government contract missions and the delivery of telecom satellites to orbit, private firms are now emerging as leaders in developing “NewSpace” activities — a catch-all term for endeavors including orbital tourism, orbital manufacturing and mini-satellites providing specialized services. The space sector, with a market capitalization of $400 billion, could grow to as much as $1 trillion by 2040 as private investment soars.

#### Space mining threatens satelites

Scoles 15 Sarah Scoles [Freelance science writer, and a contributing writer at WIRED Science, with articles in places like Popular Science, the New York Times, Scientific American, Vice, Outside, and others.], 5-27-2015, "Dust from asteroid mining spells danger for satellites," New Scientist, <https://www.newscientist.com/article/mg22630235-100-dust-from-asteroid-mining-spells-danger-for-satellites/> DD AG

IF THE gold mine is too far from home, why not move it nearby? It sounds like a fantasy, but would-be miners are already dreaming up ways to drag resource-rich space rocks closer to home. Trouble is, that could threaten the web of satellites around Earth.

Asteroids are not only stepping stones for cosmic colonisation, but may contain metals like gold, platinum, iron and titanium, plus life-sustaining hydrogen and oxygen, and rocket-fuelling ammonia. Space age forty-niners can either try to work an asteroid where it is, or tug it into a more convenient orbit.

NASA chose the second option for its Asteroid Redirect Mission, which aims to pluck a boulder from an asteroid’s surface and relocate it to a stable orbit around the moon. But an asteroid’s gravity is so weak that it’s not hard for surface particles to escape into space. Now a new model warns that debris shed by such transplanted rocks could intrude where many defence and communication satellites live – in geosynchronous orbit.

According to Casey Handmer of the California Institute of Technology in Pasadena and Javier Roa of the Technical University of Madrid in Spain, 5 per cent of the escaped debris will end up in regions traversed by satellites. Over 10 years, it would cross geosynchronous orbit 63 times on average. A satellite in the wrong spot at the wrong time will suffer a damaging high-speed collision with that dust.

The study also looks at the “catastrophic disruption” of an asteroid 5 metres across or bigger. Its total break-up into a pile of rubble would increase the risk to satellites by more than 30 per cent (arxiv.org/abs/1505.03800).

That may not have immediate consequences. But as Earth orbits get more crowded with spent rocket stages and satellites, we will have to worry about cascades of collisions like the one depicted in the movie Gravity.

#### Subpoint B:

#### Megaconstellations - Starlink has launched has hundreds of sateliltes this year that almost collided with the space station – and it’s only growing worse. Thousands of satellites in a group risk inevitable collision and disabling effects which cascade conflict

Unal 21 10/6/2021, Chatham House, “Collision risks in space due to mega-constellations”, [Dr Beyza Unal is the deputy director with the International Security programme at Chatham House.Her research includes nuclear weapons policy, cyber, space, and critical national infrastructure security, quantum technologies, and artificial intelligence applications. Beyza also leads on NATO’s security and defence policy at Chatham House.] URL: <https://www.chathamhouse.org/2021/10/collision-risks-space-due-mega-constellations>, KR

Unregulated launches of mega-constellations, however, make low Earth orbit too crowded to function safely and securely. Such congestion increases the risk of collision, such as with other active satellites, untracked debris, and meteoroids. Even a single collision in outer space can cause significant cascade effects, creating future collisions, as collisions ‘give rise to more debris and lead to more collisions’.

Near misses provide learnings

Space-faring nations and the space industry should learn from the several near miss incidents that have already taken place with single satellites and mega-constellations in outer space.

In 2018, the mission controllers of the CryoSat-2, a satellite that monitors precise changes in the thickness of polar ice sheets, had to manoeuvre their satellite into a higher orbit to prevent collision with a piece of debris. In 2019, the European Space Agency (ESA) moved its earth observation satellite to avoid it colliding with a Starlink satellite.

The collision risk, in this incident, was estimated to be ‘ten times higher than the threshold that required a collision avoidance manoeuvre’. While manoeuvring away from a piece of debris is common practice, the space industry is still learning how to manoeuvre to prevent collision with an active satellite.

The latter requires direct communication hotlines between the operators involved, at all times. Current communication between operators, however, is conducted on an ad-hoc basis and over email exchanges. This is neither sustainable nor efficient as outer space becomes even more congested, exponentially increasing the risk of collision.

Academic assessments also reveal a grim picture for the future of the on-orbit environment. By using the European Space Agency (ESA)’s debris evolutionary model, researchers tested the probability of multiple collisions of mega-satellite constellations and identified ‘significant risk from non-trackable debris objects’.

These are objects smaller than ten centimetres in size. Although non-trackable debris generally poses non-catastrophic collision risks as a result of the existing shielding in the design of the satellites, these collisions may still be able to disable key satellite functions such as communications. The loss of critical functions may have cascading impacts not only on the overall health of the mega-satellite system in question but also on the functioning of critical national infrastructure on Earth.

#### Subpoint C: Impact

#### Collisions with high-value satellites risks war

Egeli 21 [Sitki Egeli is an assistant professor in the Political Science and International Relations Department of Izmir University of Economics. He was previously a director for foreign affairs in Turkey’s Undersecretariat for Defense Industries (SSM) and vice president in charge of the defense and aerospace sectors of an international consulting firm.] “Space-to-Space Warfare and Proximity Operations: The Impact on Nuclear Command, Control, and Communications and Strategic Stability,” Published 25 Jun 2021, <https://www.tandfonline.com/doi/full/10.1080/25751654.2021.1942681>, VM

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

#### Debris cascading prevents future mining – there’s only a risk of our offense

Salter 16 [Alexander William Salter, Assistant Professor of Economics, Rawls College of Business, Texas Tech University. SPACE DEBRIS: A LAW AND ECONOMICS ANALYSIS OF THE ORBITAL COMMONS. 2016. https://law.stanford.edu/wp-content/uploads/2017/11/19-2-2-salter-final\_0.pdf]

The probability of a collision is currently low. Bradley and Wein estimate that the maximum probability in LEO of a collision over the lifetime of a spacecraft remains below one in one thousand, conditional on continued compliance with NASA’s deorbiting guidelines.3 However, the possibility of a future “snowballing” effect, whereby debris collides with other objects, further congesting orbit space, remains a significant concern.4 Levin and Carroll estimate the average immediate destruction of wealth created by a collision to be approximately S30 million, with an additional S200 million in damages to all currently existing space assets from the debris created by the initial collision.3 The expected value of destroyed wealth because of collisions, currently small because of the low probability of a collision, can quickly become significant if future collisions result in runaway debris growth.

Given the possibility of high future costs, private and public actors should, for their own benefit, direct attention to the space debris problem now. Global satellite revenue in 2014 totaled S195.2 billion.6 That stream of economic activity is most threatened by significantly increased concentrations of space debris in orbit. Other activities within the “space economy” ($320 billion in revenue in 2013) that are potentially threatened include human spaceflight and nonorbital spacecraft.7 Private-sector space activities planned for the more distant future, including space tourism and asteroid mining, will also be affected if access to orbit is complicated by space debris.

## Contention 2: Resource Conflict

#### Competition over resources creates intense conflict

**Adam Smith writes in 2020** [Adam Smith, 11-24-2020, "Scientists fear conflicts over the Moon’s resources between governments and companies," Independent, <https://www.independent.co.uk/life-style/gadgets-and-tech/moon-government-companies-resources-conflicts-b1761170.html>] [pT]

Scientists fear that the Moon might be plundered too quickly by private companies hoping to extract its valuable resources, new research has hypothesized. A lack of international policies and agreements could result in tensions, overcrowding, and a rapid expansion of moon mining projects, the Center for Astrophysics | Harvard & Smithsonian says in a new paper. Water and iron are particularly valuable resources that could be collected from the Moon, which would help companies construct infrastructure and develop agriculture as well as letting them avoid the vast expense of transporting such materials from the Earth. "A lot of people think of space as a place of peace and harmony between nations. The problem is there's no law to regulate who gets to use the resources, and there are a significant number of space agencies and others in the private sector that aim to land on the moon within the next five years," said Martin Elvis, astronomer at the Center for Astrophysics | Harvard & Smithsonian and the lead author on the paper, which has been published in [Philosophical Transactions of the Royal Society A.](http://dx.doi.org/10.1098/rsta.2019.0563) "We looked at all the maps of the Moon we could find and found that not very many places had resources of interest, and those that did were very small. That creates a lot of room for conflict over certain resources." The treaties that do exist, such as the 1967 Outer Space Treaty, do not offer staunch protection of celestial bodies from companies. The Outer Space Treaty declares that “the moon and other celestial bodies shall be used by all states parties to the treaty exclusively for peaceful purposes”, but is not exclusive to governments. The United States insisted on a clause that [allowed commercial companies to explore space](https://www.independent.co.uk/news/long_reads/if-no-one-owns-moon-can-anyone-make-money-there-space-astronomy-a8087126.html) as long as they “require authorisation and continuing supervision” of the government, as opposed to the Russian view that space exploration should be limited to governments. A following treaty, the 1979 Moon Treaty, has not been ratified by any state that engages in self-launched spaceflight such as the US, Russia, China, Japan, or members of the European Space Agency. "It tries to address the ownership of resources obtained from outer space, and really it was pretty much rejected by the international community”, Dr Jill Stuart, head of space policy at the London School of Economics, [previously told The Independent.](https://www.independent.co.uk/news/world/who-owns-outer-space-and-what-happens-when-corporations-want-extract-resources-asteroids-or-planets-10492126.html) In 2020 the [Artemis Accords were announced](https://www.independent.co.uk/life-style/gadgets-and-tech/news/nasa-moon-mission-artemis-accords-us-china-a9517091.html), which are a set of agreements that requires countries working with the US to return to the moon to commit to transparency about their work, to only explore space for “peaceful purposes”, and to guarantee they would work together to save any astronauts that came into danger during a mission. However, this still does not protect celestial bodies from being overly exploited for resources. "The biggest problem is that everyone is targeting the same sites and resources: states, private companies, everyone. But they are limited sites and resources. We don't have a second moon to move on to. This is all we have to work with." Alanna Krolikowski, assistant professor of science and technology policy at Missouri University of Science and Technology, and a co-author on the paper, said in a statement. "While a comprehensive international legal regime to manage space resources remains a distant prospect, important conceptual foundations already exist and we can start implementing, or at least deliberating, concrete, local measures to address anticipated problems at specific sites today."

#### The impact of tensions is long ranging conflict that takes thousands with it

Erin Drake 20—Erin Drake; “Conflict and Resource Scarcity Around the World”; *SRM*; Jan 15 2020; <https://insights.s-rminform.com/conflict-and-resource-scarcity-across-the-world>; (AG DebateDrills)

Resource scarcity has historically contributed to – and prolonged – various conflicts, both between states, as well as between communities or groups within states. This trend continued in 2019, exacerbated by factors such as climate change, expanding populations, and resource shortages – including water, oil and land. Resource scarcity and worsening environmental conditions will continue to play a prominent role in driving conflict dynamics across the world in the coming years. WATER WARSPV Special Edition Water Icon SRM-1 Water scarcity has fuelled longstanding disputes, due the prominent role that water plays in various sectors such as agriculture and fishing. While Southeast Asian countries dispute maritime boundaries, communities in Sub-Saharan Africa clash over water access in drought-affected areas. Militant groups – such as the Houthis in Yemen – use water as a weapon to force compliance among populations and gain political leverage, while indigenous populations in Latin America oppose large extractive companies, which they accuse of diverting and polluting water resources. In 2019, the UN estimated that around 75,000 people die annually in conflicts over water. As global warming exacerbates water scarcity in the coming years, such conflicts will likely intensify. CASE STUDIES Amid severe drought and an ongoing water crisis in India, communities in Chennai, Tamil Nadu State, and Madhya Pradesh State, clashed over access to water in June and July 2019. Security personnel were deployed to guard water facilities and escort tanker drivers amid attacks, while clashes between residents in affected areas resulted in multiple injuries. An estimated 21 major cities could run out of water in 2020. With the ongoing impact of global warming, such shortages which will likely lead to further, widespread clashes in the coming years. China, the Philippines, Vietnam, Brunei, Taiwan and Malaysia have historically made overlapping claims to territory in the South China Sea (SCS) – a vital shipping route, also accounting for over 12 percent of global commercial fishing. Due to competing claims, fishing in the SCS has also historically driven clashes between Chinese vessels – often escorted

Instead of prioritizing communal gain of resources, space becomes a free-for all leading to monopolization and lack of sharing. That means even if

#### Subpoint B:

#### This destroys sustianable ventures

Yan 18 [Laura Yan is a writer in Brooklyn. Her writing has appeared in Wired, GQ, The Cut, Pacific Standard, Longreads, The Outline, and elsewhere. Should We Really Be Mining in Space? May 5, 2018. https://www.popularmechanics.com/space/a20195040/should-we-be-really-be-mining-in-space/]

Imagine, for instance, an asteroid that contains as many platinum-group metals as all reserves on Earth. Businesses will compete for the precious resource, and the competing may soon turn into battle by armed satellites, which can lead back to conflicts on Earth. The act of mining itself could also be dangerous: if space-mining break up asteroids, it could harm other satellites, spacecrafts and astronauts.

Commerical space mining could lead to conflicts between profitability and public interest. "Once you’re on board with the commercial space industry, then you as a researcher must accept, if not support, everything that comes with it," Skibba writes. "To succeed, these businesses will seek profitable missions, while science, exploration, and discovery—goals that stimulate public interest—will inevitably have lower priority,"

## Contention 3

#### Ozone is improving in the status quo

**UN 19**, United Nations Report, 9-16-2019, "Ozone on track to heal completely in our lifetime, UN environment agency declares on World Day.," UN News, <https://news.un.org/en/story/2019/09/1046452> Livingston RB

The phaseout of controlled uses of ozone-depleting substances has not only helped replenish the protective layer for future generations but is also helping guard human health by filtering harmful rays from reaching Earth, said [UNEP](https://www.unep.org/) shared in a[statement](https://ozone.unep.org/ozone-day/32-years-and-healing). The recognition of this success comes on [World Ozone Day,](https://www.un.org/en/events/ozoneday/) marked 16 September. This year celebrates “32 Years and Healing”; a commemoration of the international commitment to protect the ozone later and the climate under the historic [Montreal Protocol](https://ozone.unep.org/sites/default/files/2019-08/MP_Handbook_2019_0.pdf), which has led to the phase-out of 99 per cent of ozone-depleting chemicals in refrigerators, air-conditioners and other consumer products. **Since 2000**, parts of **the ozone** layer **have recovered at a rate of 1-3 per cent** every ten years, the latest [Scientific Assessment of Ozone Depletion](https://www.esrl.noaa.gov/csd/assessments/ozone/2018/)estimates. At projected rates the “**Northern Hemisphere and mid-latitude ozone will heal completely by the 2030’s**”, UNEP said, with the Southern Hemisphere repaired by the 2050’s, and Polar Regions in the following decade. UN Secretary-General, António Guterres [said](https://www.unenvironment.org/news-and-stories/statement/secretary-generals-message-world-ozone-day-2019) “**we must be careful not to neglect the ozone layer**,” as we “rightly focus our energies on tackling climate change”, spotlighting the importance of preventing threats posed by emission of ozone-depleting gases**. Regenerating the ozone has helped curb the effects of climate change** - with approximately 135 billion tonnes of carbon dioxide emissions from 1990 to 2010 averted by a strong protective shield.

#### Even getting into space harms the environment by punching holes in the ozone

**Mortillaro 21**, Nicole Mortillaro · Cbc News · Posted, 4-22-2021, "Rocket launches could be affecting our ozone layer, say experts," CBC, <https://www.cbc.ca/news/science/rocket-launches-environment-1.5995252> Livingston RB

Rocket launches are a breathtaking culmination of human ingenuity as they propel us into the future, but there is a growing concern that not enough research has been done on their effect on the environment. While some may be worried about potential greenhouse gas emissions that's not the main issue. Instead, **it's ozone depletion and the potential effects in our upper atmosphere,** specifically the stratosphere, **along with concerns about toxic fuels.** **The problem has flown under the radar**, according to Martin Ross, an atmospheric scientist at The Aerospace Corporation, **because people still think of rocket launches as rare**.  But it's time to face the fact that we may be entering a boom era, he said. "One of the arguments that people have used in the past was to say that we don't really need to pay attention to rockets or to the space industry, or the space industry is small, and it's always going to be small," Ross said.  "But I think the developments that we're seeing the past few years show that … space is entering this very rapid growth phase like aviation saw in the '20s and '30s." The stratosphere is an important weather driver for Earth's systems, and that's where some particles from rocket launches are ending up. **The ozone layer, which helps protect us from the sun's** harmful ultraviolet **rays**, is also located in the stratosphere. In 1990, the [Montreal Protocol was signed into law](https://ozone.unep.org/treaties/montreal-protocol), banning harmful ozone-depleting substances, such as chlorofluorocarbons (CFCs), used in things like refrigerators and air conditioners, after it was revealed that the ozone layer was being stripped away by these chemicals. While the protocol touched on airlines, there was no mention of the aerospace industry. But now some industry experts are concerned that with no oversight, we could be in for a problem**. There are different types of rocket propellants**. Some, like liquid oxygen and liquid hydrogen, produce mainly water vapour and have little environmental impact. These were used in past shuttle launches and even in the Apollo-era Saturn V vehicles.  Then there are those that produce alumina particles in the stratosphere, such as those in solid rocket boosters, which were also used in past shuttle launches, and are still being used today by some launch companies. Finally, **there are those that deposit black soot in the stratosphere, such as kerosene used in SpaceX's Falcon** 9 and Russia's Soyuz rockets. **It's the alumina and black soot that is most concerning to experts.** "The atmosphere is complex," said Jessica Dallas, a PhD candidate at the Australian Centre for Space Engineering Research, in New South Wales. "We don't have a complete understanding of atmospheric circulation and how all of the mechanisms in the atmosphere actually work. And so that means that we also don't have a good idea of what happens when we're injecting these particles into the stratosphere."

**PLAY SOUND**

Private companies are the ones doing the majority of space launches and that’s bound to grow

Elizabeth howell writes In 2018 Elizabeth Howell, 2-28-2017, "SpaceX's Falcon 9: Rocket for the Dragon," Space, https://www.space.com/18962-spacex-falcon-9.html

But even on the business side, there is so much activity playing out it's hard to keep track of it all. Hidden behind some of the company's more high-profile achievements this year (think Starship landing, [Starlink](https://www.space.com/spacex-starlink-satellites.html) and human spaceflight launches) is the powerhouse [Falcon 9](https://www.space.com/18962-spacex-falcon-9.html) rocket. Musk wanted to reach [48 launches](https://twitter.com/elonmusk/status/1312249542125842434) of the system in 2021; although SpaceX didn't get nearly that far, the company did set a new record of 31 launches by December's end, with payloads ranging from military satellites to parts of its own megaconstellation of Starlink internet satellites. The company also successfully [landed a rocket for the 100th time](https://www.space.com/spacex-dragon-crs-2-launch-100th-rocket-landing-success) and flew a Falcon 9 for [a record 11 times](https://www.space.com/spacex-starlink-launch-record-falcon-9-11th-flight) in December to cap off the year. "SpaceX almost has a monopoly of launchers — not only human, but also unmanned as well," Pablo de Leon, chair of the University of North Dakota's space studies department, told Space.com. De Leon is also a long-time researcher at the Kennedy Space Center in Florida on aspects of human spaceflight, especially spacesuits (a growth area for the university) and long ago, on payloads for the space shuttle program. He's seen SpaceX's modifications to Pad 39B at KSC in support of its [Starship](https://www.space.com/spacex-starship-super-heavy.html) program that will eventually, if Musk's plans come to fruition, bring the company to the moon and Mars.In our [recent research](https://www.hbs.edu/faculty/Publication%20Files/jep.32.2.173_Space,%20the%20Final%20Economic%20Frontier_413bf24d-42e6-4cea-8cc5-a0d2f6fc6a70.pdf), we examined how the model of centralized, government-directed human space activity born in the 1960s has, over the last two decades, made way for a new model, in which public initiatives in space increasingly share the stage with private priorities. Centralized, government-led space programs will inevitably focus on space-for-earth activities that are in the public interest, such as national security, basic science, and national pride. This is only natural, as expenditures for these programs must be justified by demonstrating benefits for citizens — and the citizens these governments represent are (nearly) all on earth. In contrast to governments, the private sector is eager to put people in space to pursue their own personal interests, not the state’s — and then supply the demand they create. This is the vision driving SpaceX, which in its first twenty years has entirely upended the rocket launch industry, securing 60% of the global commercial launch market Today, the space-for-space market is limited to supplying the people who are already in space: that is, the handful of astronauts employed by NASA and other government programs. While SpaceX has grand visions of supporting large numbers of private space travelers, their current space-for-space activities have all been in response to demand from government customers (i.e., NASA). But as decreasing launch costs enable companies like SpaceX to leverage economies of scale and put more people into space, growing private sector demand (that is, tourists and settlers, rather than government employees) could turn these proof-of-concept initiatives into a sustainable, large-scale industry

#### Ozone is key to quality of life and human survival

**European Commission ND**, “Protection of the ozone layer” European Commission Official Website, <https://ec.europa.eu/clima/eu-action/protection-ozone-layer_en> Livingston RB

**World governments agreed** in the late 1980s **to protect th**e Earth’s **ozone** layer by phasing out ozone-depleting substances emitted by human activities, **under the Montreal Protocol**. In Europe, the Protocol is implemented through EU-wide legislation that not only meets its objectives but also contains stricter, more ambitious measures. Global action taken under the Montreal Protocol has halted the depletion of the ozone layer and allowed it to start recovering, but much remains to be done to ensure a steady recovery. **The ozone layer** is a natural layer of gas in the upper atmosphere that **protects humans and other living things from harmful ultraviolet (UV) radiation from the sun**. Although ozone is present in small concentrations throughout the atmosphere, most (around 90%) exists in the stratosphere, a layer 10 to 50 kilometres above the Earth’s surface. **The ozone** layer filters out most of the sun's harmful UV radiation and **is therefore crucial to life on Earth**. Scientists discovered in the 1970s that the ozone layer was being depleted. Atmospheric concentrations of ozone vary naturally depending on temperature, weather, latitude and altitude, while substances ejected by natural events such as volcanic eruptions can also affect ozone levels. However, these natural phenomena could not explain the levels of depletion observed and scientific evidence revealed that certain man-made chemicals were the cause. These ozone-depleting substances were mostly introduced in the 1970s in a wide range of industrial and consumer applications, mainly refrigerators, air conditioners and fire extinguishers.