## Contention 1 is Warming

#### Subpoint a is space mining

#### 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 is the only way to solve climate change

Duran 21, (Paloma Duran is a journalist and industry analyst at Mexico Business News, “Is Space Mining the Best Option to Face Climate Change?”), 11-03-21, Mexico Business News, https://mexicobusiness.news/mining/news/space-mining-best-option-face-climate-change // MNHS NL

Going to net zero means that more mining is needed. Experts have said that the current supply cannot support the necessary metals demand for the green transition. As a result, new mining alternatives have gained greater relevance, among them is space mining. Several countries, including Mexico, have shown their interest in this alternative, creating a new space race. “The solar system can support a billion times greater industry than we have on Earth. When you go to vastly larger scales of civilization, beyond the scale that a planet can support, then the types of things that civilization can do are incomprehensible to us … We would be able to promote healthy societies all over the world at the same time that we would be reducing the environmental burden on the Earth,” said Dr. Phil Metzger, Planetary Scientist at the University of Central Florida. Currently, there are several attempts to address global warming and transition to a net zero carbon economy. There has been an increasing interest in renewable energy and infrastructure, which has increased demand for various minerals, especially lithium, cobalt, nickel, copper and rare earth elements. However, according to experts, the world is close to entering a metals supercycle, where demand will exceed available supply, causing prices to skyrocket. Consequently, the mining industry has sought alternatives to achieve the required supply. Options include recycling and improved mine waste management, sea mining and space mining. The latter is considered one of the alternatives with the greatest potential. However, a regulatory framework is still lacking and there is almost no experience in this regard. Despite the lack of knowledge regarding space mining, it has become a very attractive option since the planet is running out of resources. While some people believe that land-based mining is cheaper than space mining, experts believe this may change in the long term. Furthermore, within the solar system there are countless bodies rich in minerals, ores and elements that will accelerate the fight against climate change. “There will come a point when there is nothing left to mine on the surface, prompting mines to reach even further below. But even those resources are destined to run out and so we will aim toward ocean mining, which already has specific technologies that are being developed. Nevertheless, even those mines are limited as well. The mine of the future, which today may seem unlikely, will no longer be on our planet. There will be a time when space mining will be as common as an open leach mine,” Eder Lugo, Minerals Head at Siemens, told MBN. More than 150 million asteroids measuring approximately 100m are believed to be in the inner solar system alone. In addition, astronomers have also identified abundant minerals near the Earth’s space and the Main Asteroid Belt. There are three main groups into which asteroids are divided: C- type, S- type, and M- type. The last two groups are the most abundant in minerals such as gold, platinum, cobalt, zinc, tin, lead, indium, silver, copper and rare earth metals. "Energy is limited here. Within just a few hundred years, you will have to cover all of the landmass of Earth in solar cells. So, what are you going to do? Well, what I think you are going to do is you are going to move out in space … all of our heavy industry will be moved off-planet and Earth will be zoned residential and light-industrial,” said Jeff Bezos, Founder of Amazon and the Space Launch Provider Blue Origin.

#### Subpoint b is solar tech

#### Space-solar tech coming now, private entities are key – it’s impossible to be weaponized

Snowden 19 (Mar 12, 2019,01:29pm EDT|48,669 views Solar Power Stations In Space Could Supply The World With Limitless Energy Scott Snowden Scott SnowdenContributor Sustainability, Forbes, <https://www.forbes.com/sites/scottsnowden/2019/03/12/solar-power-stations-in-space-could-supply-the-world-with-limitless-energy/?sh=229b778b4386)//ww> pbj

While on the surface of the Earth, society still struggles to adopt solar energy solutions, many scientists maintain that giant, space-based solar farms could provide an environmentally-friendly answer to the world's energy crisis. Only last week, we reported that China was planning to build the world's first solar power station to be positioned in Earth's orbit. Because the sun always shines in space, an orbital solar power station is seen as an inexhaustible source of clean energy. "Above the Earth, there's no day and night cycle and no clouds or weather or anything else that might obstruct the sun's ray, so a constant power source is available," said Ali Hajimiri, professor of electrical engineering at the California Institute of Technology and co-director of the university’s Space Solar Power Project. The multi-rotary SPS (MR-SPS) concept is one with multiple independent solar sub-arrays used to... [+] point to the sun. The multi-rotary SPS (MR-SPS) concept is one with multiple independent solar sub-arrays used to... [+] NASA Collecting solar power in space and wirelessly transmitting was first described by Isaac Asimov in 1941 in his short story Reason. In 1968, American aerospace engineer Peter Glaser published the first technical article on the concept – Power From The Sun: Its Future in the journal Science. Space-based solar power attracted considerable attention in the 1970s as the necessary individual technical components – in essence, photovoltaic cells, satellite technology and wireless power transmission – were developed. Despite the concept being technically feasible, it was considered economically unrealistic at the time and research ultimately stalled. “The idea seems to be going through a resurgence and it’s probably because the technology exists to make it happen,” said John Mankins, a former NASA scientist who was at the forefront of this field in the 1990s, before it was abandoned. Aerospace engineer Peter Glaser first wrote about the idea in 1968. Aerospace engineer Peter Glaser first wrote about the idea in 1968. SCIENCE MAGAZINE Global energy demands are only going to grow, says Hajimiri. The global population is expected to reach a staggering 9.6 billion by 2050, according to a United Nations report, so methods of generating large quantities of clean energy must be found. A space-based solar power system could provide energy to everyone, even in places that don't receive sunlight all year round, like northern Europe and Russia. In April of 2015, a research agreement between Northrop Grumman and Caltech provided up to $17.5m for the development of innovations necessary to enable a space solar power system. Three Caltech professors head up the project: joining Hajimiri were Harry Atwater and Sergio Pellegrino. Caltech is just one institution working on developing this technology. We know that scientists at the Chongqing Collaborative Innovation Research Institute for Civil-Military Integration in China are constructing a facility to test the theoretical viability of the concept and plans to develop an orbital photovoltaic array were announced in Japan some time ago. One of the biggest issues to overcome is that of getting an array of solar panels large enough to make the project viable into orbit. Early concept designs in the 1970s featured giant arrays that would've proved very difficult to actually get into orbit. "The systems of the 70s for solar power satellites, the cost estimates suggested, at that time, that it might be as much as a trillion dollars to get to the first kilowatt hour because of the way the designs worked. Essentially a single satellite, a platform, an integrated, monolithic platform about the size of Manhattan," said Mankins. However, with SpaceX and Blue Origin slowly driving the cost of orbital delivery down, suddenly the concept seems a little closer to reality. "Going to modular systems to allow mass production, I believe was the answer to how to get solar power satellite costs down to something more reasonable," said Mankins. Proposed space solar array SPS-ALPHA, image and concept courtesy John C. Mankins. Proposed space solar array SPS-ALPHA, image and concept courtesy John C. Mankins. JOHN C. MANKINS Details of China's proposed plans have not been made public, but most concept designs that exist today are based around an idea that the photovoltaic array is composed of a lightweight, deployable structure made of many smaller "solar satellites" that could easily connect together in space to form much larger array and "harvest sunlight." Equally, this approach also makes assembly, maintenance and repair considerably easier. "I've seen a presentation on what they [China] are presumably doing. I can't guarantee that's actually it, but it was by them, about the space solar system. What I've seen appears to be a conventional approach, which is similar to what people are currently contemplating," said Hajimiri. This completed array would orbit about 22,000 miles above the Earth and "beam" the energy back down to the surface. The photovoltaic array converts the sunlight into electricity, which in turn is converted into RF electrical power (microwaves) that are beamed wirelessly to ground-based receivers. These would take the form of giant wire nets measuring up to four miles across that could be installed across deserts or farmland or even over lakes. A solar facility like this could generate a constant flow of 2,000 gigawatts of power, Mankins estimates, compared to the largest solar farm that exists today in Aswan, southern Egypt, that only generates in the region of 1.8 gigawatts. It's unlikely the solar array could be weaponized into a "death ray" like the one seen in Diamonds... [+] Are Forever. It's unlikely the solar array could be weaponized into a "death ray" like the one seen in Diamonds... [+] MGM/UNITED ARTISTS An orbiting solar array, collecting and storing massive amounts of energy that's beamed to the surface... You'd be forgiven for thinking this could be the plot of a James Bond movie, if this array was somehow weaponized. Thankfully, that's not how it works. "The energy densities will not exceed what you normally would get. It would definitely not exceed what you get from the sun," said Hajimiri. The microwaves that transmit the energy to the surface would be at the so-called non-ionizing radiation frequency. "What that means is that the frequencies are such that unlike x-rays, these are the frequencies at which their photons don't have enough energy to induce chemical change, like that ultraviolet or x-rays do," said Hajimiri. "I've been working on wireless power transmitters that would operate in the microwave frequency range, between about 2 gigahertz and 8 gigahertz, roughly. Wavelengths on the order of 10 to 2 inches. Those wavelengths of electromagnetic radiation can pass through the Earth's atmosphere, including clouds and weather, without interruption, without interference." However, Mankins expects there might still be some problems. "There's always the geopolitics issue. Because when you're at an equatorial orbit, geostationary Earth orbit, you can see a great deal of the Earth below you. For me, it's challenging to envision how there would ever be agreement to allow such a thing." The team at Caltech have successfully tested their proof of concept on the ground, their photovoltaic prototypes demonstrated they can collect and wirelessly transmit 10 gigahertz of power, so the next step is to perform scaled down experiments in space. The biggest challenge is to reduce the mass as much as possible without sacrificing efficiency. Of course, that would also help reduce cost, which is probably still the biggest hurdle. "Hopefully, we'll be able to test it in space within a couple of years," said Hajimiri. "Space solar power would transform our future in space and could provide a new source of virtually limitless and sustainable energy to markets across the world," said Mankins. "Why wouldn't we pursue it?"

#### Space renewable shift is inevitable and good – squo energy habits are unsustainable, only space-solar energy solves

Crawford 10/5 (Mark Crawford is an engineering and technology writer in Corrales, N.M. Space-Based Solar Power Offers Out-of-This World Challenges Oct 5, 2021, ASME, <https://www.asme.org/topics-resources/content/space-based-solar-power-offers-out-of-this-world-challenges)//ww> pbj

Fossil fuels comprise over three-quarters of the world’s energy consumption. These dwindling resources can only support our transportation and energy needs for another 50 to 100 years. In addition, the energy sector is the world’s greatest polluter, releasing nearly one-third of global greenhouse gas emissions, according to the Center for Climate and Energy Solutions. Depletion of oil, gas, and coal reserves will eventually force the world to shift to clean, renewable resources, especially solar energy, which is plentiful. However, solar panels have a maximum efficiency of about 22 percent and are further impacted by external factors, such as limited daylight hours or bad weather. During winter in Europe, for example, as little as three percent of sunlight reaches the earth. These limitations on solar efficiency would be removed by using satellites to collect solar energy in space and beam it to collection sites on Earth. Space-based solar panels can generate 2,000 GW of power constantly, or about 40 times more energy than a solar panel would generate on Earth, according to the National Space Society. More for You: Infographic: Floating Solar Rides the Waves To make space-based solar power (SBSP) feasible on a global scale, several main systems are required: Low-cost, reusable launch vehicles to get materials into space Very large, lightweight, advanced satellite solar panels for in-orbit construction Microwave-transmitting satellites and laser-transmitting satellites, equipped with solar collectors, reflectors, and transmitters Receiving centers built on Earth to receive and distribute this energy. “There are many technical challenges to overcome to ensure that these systems are practical and affordable such as safety, cost, and durability,” states Karen L. Jones, senior project leader and technology strategist with the Center for Space Policy and Strategy. “For example, when beaming power down to Earth, the power densities of microwave beams must be low enough to avoid any real or perceived health and safety concerns.” Other challenges include figuring out how to launch such large solar collection systems into orbit in an affordable way. Solar panels on the International Space Station cover about 2,500 square meters; SBSP solar reflectors could stretch to three kilometers. Space-based solar energy innovators and operators will also need to design their systems to withstand the harsh space environment and offer reliable energy. Key mechanical engineering challenges include robotics and on-orbit assembly and modularity. “Modularity will be essential for assembling lightweight structures that are large enough to capture solar rays in a heliostat reflector array,” said Jones. “These building blocks must be both interoperable and have some level of autonomy. So we need standards in key areas that enable on-orbit assembly, for example, mechanical, electrical, power, thermal, and data interfaces. ASME has been a key player in standards development and should consider a role in standards development as space-based solar power continues to mature.” The U.S. Naval Research Laboratory launched an orbital SPS experiment on the X-37B space plane in May 2020 to test the viability of space-based solar power systems, including converting sunlight to microwaves and analyzing the antenna’s energy conversion process and resulting thermal performance. The U.S. Air Force Laboratory has partnered with Northrop Grumman and others to develop advanced SBSP technologies. For example, the University of Toledo is developing photovoltaic energy sheets that would harvest solar energy and transmit the power wirelessly to Earth. These flexible solar cell sheets would be assembled and interconnected into much larger structures that could include tens of millions of sheets and extend to sizes as large as a square mile. China also plans to use a new super heavy-lift rocket to construct a large space-based solar gigawatt-level power station by 2050. One way to create such a large system is by launching tens of thousands of “solar satellites” covered with photovoltaic panels that are programmed to connect in space to form an enormous cone-shaped collection and transmission system. The solar energy would be beamed wirelessly to ground-based receivers of large wire nets measuring up to four miles across. Researchers at the Japan Aerospace Exploration Agency continue to work on using microwaves to transmit energy, based on their successful experiments in 2015 that successfully used microwaves to transmit electric power. The team was able to deliver 1.8 kW of power through the air with pinpoint accuracy to a receiver about 170 feet away, proving that the technology is viable. The target market for space-based solar power, at least in its early operational stages, could be discrete applications rather than broad commercial opportunities with utility-scale terrestrial facilities that supply power grids. Jones, who recently wrote Space-Based Solar Power: A Near Term Investment Decision wrote with co-author James Vedda, notes that emerging markets for space-based solar power could include on-demand power-beaming for for forward-deployed military bases. "These bases have relied on very dangerous caravans to deliver fuel to the troops," she said. "Nearly two-thirds of coaltion deaths in Iraq and Afghanistan were related to fuel-transporation activities." Similar opportunities may include other terrestrial applications where agile and on-deman beaming capabilities are needed for disaster zones and other types of remote and isolated communities, and powering untethered remote assets such as drones and distributed infrastructure and Internet of Things devices. "Regardless of how we envision the future," said Jones, "there will be surprises regarding future applications for wireless power transmission."

**Warming causes extinction & turns every impact – no adaptation & each degree is worse**

**Krosofsky ’21** [Andrew, Green Matters Journalist, “How Global Warming May Eventually Lead to Global Extinction”, Green Matters, 03-11-2021, https://www.greenmatters.com/p/will-global-warming-cause-extinction]//pranav

Eventually, yes. **Global warming will invariably result in the mass extinction of millions of different species,** humankind included. In fact, **the Center for Biological Diversity says that global warming is currently the greatest threat to life on this planet**. **Global warming causes a number of detrimental effects on the environment that many species won’t be able to handle long-term**. Extreme weather patterns are shifting climates across the globe, eliminating habitats and altering the landscape. **As a result, food and fresh water sources are being drastically reduced**. Then, of course, **there are the rising global temperatures themselves, which many species are physically unable to contend with**. Formerly frozen arctic and antarctic regions are melting, increasing sea levels and temperatures. Eventually, **these effects will create a perfect storm of extinction conditions**. The melting glaciers of the arctic and the searing, **unmanageable heat indexes being seen along the Equator are just the tip of the iceberg, so to speak.** **The species that live in these climate zones have already been affected by the changes caused by global warming.** Take polar bears for example, whose habitats and food sources have been so greatly diminished that they have been forced to range further and further south. **Increased carbon dioxide levels in the atmosphere and oceans have already led to ocean acidification**. **This has caused many species of crustaceans to either adapt or perish and has led to the mass bleaching of more than 50 percent of Australia’s Great Barrier Reef**, according to National Geographic. According to the Center for Biological Diversity, the current trajectory of global warming predicts that more than 30 percent of Earth’s plant and animal species will face extinction by 2050. By the end of the century, that number could be as high as 70 percent. We won’t try and sugarcoat things, humanity’s own prospects aren’t looking that great either. According to The Conversation, **our species has just under a decade left to get our CO₂ emissions under control. If we don’t cut those emissions by half before 2030, temperatures will rise to potentially catastrophic levels. It may only seem like a degree or so, but the worldwide ramifications are immense.** The human species is resilient. We will survive for a while longer, even if these grim global warming predictions come to pass, **but it will mean less food, less water, and increased hardship across the world — especially in low-income areas and developing countries. This increase will also mean more pandemics, devastating storms, and uncontrollable wildfires**.

## Contention 2 is Water Shortages

#### Climate change exacerbates existing water shortages

**World Meteorological Organization 10/5** (World Meteorological Organization, 5-10-2021, "Wake up to the looming water crisis, report warns," World Meteorological Organization, <https://public.wmo.int/en/media/press-release/wake-looming-water-crisis-report-warns>) // VS

Geneva 5 October 2021 - Water-related hazards like floods and droughts are increasing because of climate change. The number of people suffering water stress is expected to soar, exacerbated by population increase and dwindling availability. But management, monitoring, forecasting and early warnings are fragmented and inadequate, whilst global climate finance efforts are insufficient according to a new multi-agency report. The State of Climate Services 2021: Water highlights the need for urgent action to improve cooperative water management, embrace integrated water and climate policies and scale up investment in this precious commodity which underpins all the international goals on sustainable development, climate change adaptation and disaster risk reduction. “Increasing temperatures are resulting in global and regional precipitation changes, leading to shifts in rainfall patterns and agricultural seasons, with a major impact on food security and human health and well-being,” says World Meteorological Organization Secretary-General Prof. Petteri Taalas. “This past year has seen a continuation of extreme, water-related events. Across Asia, extreme rainfall caused massive flooding in Japan, China, Indonesia, Nepal, Pakistan and India. Millions of people were displaced, and hundreds were killed. But it is not just in the developing world that flooding has led to major disruption. Catastrophic flooding in Europe led to hundreds of deaths and widespread damage,” he said. “Lack of water continues to be a major cause of concern for many nations, especially in Africa. More than two billion people live in water-stressed countries and suffer lack of access to safe drinking water and sanitation,” he told the official high-level launch event. “We need to wake up to the looming water crisis,” said Prof. Taalas. The report was coordinated by WMO and contains input from more than 20 international organizations, development agencies and scientific institutions. It is accompanied by a Story Map. Water-related hazards and stress Terrestrial Water Storage (TWS) trends of the past 20 years (2002-2021) According to figures cited in the report, 3.6 billion people had inadequate access to water at least one month per year in 2018. By 2050, this is expected to rise to more than five billion. In the past 20 years, terrestrial water storage – the summation of all water on the land surface and in the subsurface, including soil moisture, snow and ice – has dropped at a rate of 1cm per year. The biggest losses are occurring in Antarctica and Greenland, but many highly populated lower latitude locations are experiencing significant water losses in areas that are traditionally providing water supply, with major ramifications for water security. The situation is worsening by the fact that only 0.5% of water on Earth is useable and available freshwater. Water-related hazards have increased in frequency over the past 20 years. Since 2000, flood-related disasters have risen by 134% compared with the two previous decades. Most of the flood-related deaths and economic losses were recorded in Asia, where end-to-end warning systems for riverine floods require strengthening. The number and duration of droughts also increased by 29% over this same period. Most drought-related deaths occurred in Africa, indicating a need for stronger end-to-end warning systems for drought in that region.

#### Companies such as Moon Express plan to mine on the moon for water – legislation has already created an incentive and legalization of extraction of space resources.

Basulto ’15 [Dominic Basulto, 11-18-2015, "How property rights in outer space may lead to a scramble to exploit the moon’s resources," Washington Post, <https://www.washingtonpost.com/news/innovations/wp/2015/11/18/how-property-rights-in-outer-space-may-lead-to-a-scramble-to-exploit-the-moons-resources/?tid=usw_passupdatepg>] //akhileshp

This week the U.S. House of Representatives passed legislation known as the SPACE Act of 2015 ([The U.S. Commercial Space Launch Competitiveness Act](https://www.congress.gov/bill/114th-congress/house-bill/2262/text)), which recognizes and promotes the rights of U.S. companies to engage in the exploration and extraction of space resources from asteroids and other celestial bodies. That’s a huge win for private space exploration companies, especially for companies with upcoming plans to tap into the economic potential of the moon. That’s because the legislation, in its definition of “space resources,” is sufficiently broad to include resources found on the lunar surface. In short, the moon could now be in play for some of America’s most innovative space exploration companies. One of those companies is [Moon Express](http://moonexpress.com/), a privately funded commercial space company with [an audacious plan to mine the surface of the moon](https://www.washingtonpost.com/news/innovations/wp/2015/03/19/an-audacious-plan-to-mine-the-surface-of-the-moon/?itid=lk_inline_manual_5). As Bob Richards, co-founder and CEO of Moon Express, told me, minerals and water found on the moon would be technically classified as a “space resource” according to Title IV of the SPACE Act, which defines “space resource” simply as “an abiotic resource in situ in outer space.” “The key to unlocking the economic potential of the moon is the water on the moon,” Richards said. “Water is the ‘oil of the solar system,’ and can be used to create rocket fuel that changes the economics of space resources, not just on the moon, but throughout the solar system. So our initial goal is to locate and learn how to mine and stockpile the water on the moon. We’re effectively after our first gusher.” And it’s not just Moon Express interested in finding water on the moon. Mining the moon for water has attracted the attention of [Shackleton Energy Resources](http://www.shackletonenergy.com/overview/#goingbacktothemoon), which suggests that [there are billions of tons of water ice on the poles of the moon](http://www.shackletonenergy.com/overview/#goingbacktothemoon) that might be converted into rocket fuel. Moreover, NASA has [two different mission concepts for extracting water from the lunar surface](http://www.space.com/27388-nasa-moon-mining-missions-water.html). If there’s ever going to be human lunar colony, then finding water on the moon is going to be a priority. It’s just cheaper and easier to have a source of water on the moon than it is to bring water to the moon. [In introducing the SPACE Act legislation for a vote Monday night](http://www.majorityleader.gov/2015/11/16/the-future-of-space-exploration-is-now/), House Majority Leader (R-Calif.) Kevin McCarthy invoked the inspiring examples of both Kitty Hawk and Chuck Yeager breaking the sound barrier and cited the extraordinary innovation already happening around commercial space exploration: With this law, I have great hope for the future of space exploration. You know, whenever I visit the Mojave Air and Spaceport, where so many of our advancements are happening, I’m overwhelmed by the feeling that the future is now… Upon the firm foundation of the SPACE Act, I know they and others will lead us far and that our limits are only bounded by what we can imagine as we continue our journey to the stars. When it comes to outer space, however, there’s the matter of a pesky little document known as the [Outer Space Treaty of 1967](http://www.unoosa.org/oosa/SpaceLaw/outerspt.html), to which the United States is a signatory. The Outer Space Treaty indirectly suggests that commercial space companies don’t own the rights to any resources they find in outer space. The treaty states that no “celestial body” is subject to “national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” The SPACE Act of 2015 carefully skirts this issue by specifically making a disclaimer that the United States “does not thereby assert sovereignty or sovereign or exclusive rights or jurisdiction over, or the ownership of, any celestial body.” Clever, right? If there’s no U.S. sovereign claim, then the Outer Space Treaty can’t be applicable to private U.S. companies that assert a similar type of claim. When asked about a hypothetical example in which a Chinese company or even the Chinese government might contest the rights of a U.S. company to space resources, Richards suggests that the SPACE Act would provide a sufficient legal basis. “It’s hard to imagine what challenge China or any other country could mount against this U.S. legislation, which is about rights to materials obtained, not territory, and is really just codifying principles and rights already in the 1967 Outer Space Treaty that have been demonstrated by multinational activities on the moon as applicable to the private sector.” Nearly 50 years ago, of course, we didn’t know anything about the economic potential of space and nobody was seriously talking about humans as an interplanetary species. Certainly, there were not any private companies angling for a piece of the action. Space exploration was solely the preserve of sovereign governments and [we referred to astronauts as the “envoys of mankind.”](http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html) The prevailing sentiment, [as expressed in the Outer Space Treaty](http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html), was that outer space should belong to all of humanity, not just the first nation to venture into space and plant a flag on the surface of a celestial body. What’s happening now, in essence, is [a sea change in how we think about outer space](https://www.washingtonpost.com/news/innovations/wp/2015/02/12/one-small-step-for-man-one-giant-step-for-the-commercialization-of-the-moon/?itid=lk_inline_manual_23). To convince private commercial space exploration companies to invest millions of dollars, there have to be economic incentives involved. In short, financial backers of these companies have to be able to realize a profit from their investments if innovation is going to happen. That’s the reality. Richards cites the rights of fishing boats in international waters as an economic template for the SPACE Act, “The ships are owned by companies flying flags of nations under which laws they are bound: they have a right to peacefully fish in international waters that they don’t own; but they have a right of ownership of the fish once obtained.” The fishing analogy is a useful one. It suggests that we’re simply extending the same economic principles used on Earth to the moon and beyond, not creating new principles. Seafaring nations are now spacefaring nations. [Moon Express even refers to the moon as “the eighth continent,”](http://moonexpress.com/) suggesting that people should think about the moon the same way they think about the other seven continents on the planet. And Planetary Resources, an asteroid mining company, refers to the [“off-planet economy.”](http://www.planetaryresources.com/2015/11/planetary-resources-applauds-u-s-congress-in-recognizing-asteroid-resource-property-rights/) Throughout the annals of exploration, there have always been commercial incentives. Would the untapped economic potential of America have been possible without similar types of incentives? [One example cited by backers of the SPACE Act is the Homestead Act of 1862](http://www.planetaryresources.com/2015/11/planetary-resources-applauds-u-s-congress-in-recognizing-asteroid-resource-property-rights/), which paved the way for Americans to search for gold and timber. Governments they say, have an important role to play here by passing legislation that catalyzes, rather than stifles, growth and innovation. For supporters of the SPACE Act, the year 2017 looms large. That’s exactly 50 years since the passage of the 1967 Outer Space Treaty. And it’s also the deadline for winning the [$30 million Google Lunar X-PRIZE](http://lunar.xprize.org/). If privately owned companies are going to be landing on the surface of the moon within the next 24 months, they are going to want assurances that their innovative efforts now are going to have an economic payoff later.

#### Asteroid mining solves water access – only NEAs are sufficiently proximate and hydrated

Tillman 19 (Nola Taylor, has been published in Astronomy, Sky & Telescope, Scientific American, New Scientist, Science News (AAS), Space.com, and Astrobiology magazine, BA in Astrophysics) “Tons of Water in Asteroids Could Fuel Satellites, Space Exploration,” Space, 9/29/2019) // JL // recut by VS

When it comes to mining space for water, the best target may not be the moon: Entrepreneurs' richest options are likely to be asteroids that are larger and closer to Earth. A recent study suggested that roughly 1,000 water-rich, or hydrated, asteroids near our planet are easier to reach than the lunar surface is. While most of these space rocks are only a few feet in size, more than 25 of them should be large enough to each provide significant water. Altogether, the water locked in these asteroids should be enough to fill somewhere around 320,000 Olympics-size swimming pools — significantly more than the amount of water locked up at the lunar poles, the new research suggested. Because asteroids are small, they have less gravity than Earth or the moon do, which makes them easier destinations to land on and lift off from. If engineers can figure out how to mine water from these space rocks, they could produce a source of ready fuel in space that would allow spacecraft designers to build refuelable models for the next generation of satellites. Asteroid mining could also fuel human exploration, saving the expense of launching fuel from Earth. In both cases, would-be space-rock miners will need to figure out how to free the water trapped in hydrated minerals on these asteroids. "Most of the hydrated material in the near-Earth population is contained in the largest few hydrated objects," Andrew Rivkin, an asteroid researcher at Johns Hopkins University Applied Physics Research Laboratory in Maryland, told Space.com. Rivkin is the lead author on the paper, which estimated that near Earth asteroids could contain more easily accessible water than the lunar poles. According to the United Nations Office for Outer Space Affairs, more than 5,200 of the objects launched into space are still in orbit today. While some continue to function, the bulk of them buzz uselessly over our heads every day. They carry fuel on board, and when they run out, they are either lowered into destructive orbits or left to become space junk, useless debris with the potential to cause enormous problems for working satellites. Refueling satellites in space could change that model, replacing it with long-lived, productive orbiters. "It's easier to bring fuel from asteroids to geosynchronous orbit than from the surface of the Earth," Rivkin said. "If such a supply line could be established, it could make asteroid mining very profitable." Hunting for space water from the surface of the Earth is challenging because the planet's atmosphere blocks the wavelength of light where water can be observed. The asteroid warming as it draws closer to the sun can also complicate measurements. Instead, Rivkin and his colleagues turned to a class of space rocks called Ch asteroids. Although these asteroids don't directly exhibit a watery fingerprint, they carry the telltale signal of oxidized iron seen only on asteroids with signatures of water-rich minerals, which means the authors felt confident assuming that all Ch asteroids carry this rocky water. Based on meteorite falls, a previous study estimated that Ch asteroids could make up nearly 10% of the near-Earth objects (NEOs). With this information, the researchers determined that there are between 26 and 80 such objects that are hydrated and larger than 0.62 miles (1 km) across. Right now, only three NEOs have been classified as Ch asteroids, although others have been spotted in the asteroid belt. Most NEOs are discovered and observed at wavelengths too short to reveal the iron band that marks the class. Carbon-rich asteroids, which include Ch asteroids and other flavors, are also darker than the more common stony asteroids, making them more challenging to observe. Although Ch asteroids definitely contain water-rich minerals, that doesn’t necessarily mean that they will always be the best bet for space mining. It comes down to risk. Would an asteroid-mining company rather visit a smaller asteroid that definitely has a moderate amount of water, or a larger one that could yield a larger payday but could also come up dry? "Whether getting sure things with no false positives, like the Ch asteroids, is more important or if a greater range of possibilities is acceptable with the understanding that some asteroids will be duds is something the miners will have to decide," Rivkin said. In addition to estimating the number of large, water-rich asteroids might be available, the study also found that as many as 1,050 smaller objects, roughly 300 feet (100 meters) across, may also linger near Earth. Their small bulk will make them easier to mine (and) because their low gravity will require less fuel to escape from, but they will produce less water overall, and Rivkin expects that the handful of larger space rocks will be the first targets. "It seems likely that the plan for these companies will be to find the largest accessible asteroid with mineable material with the expectation that it will be more cost-effective than chasing down a large number of smaller objects," Rivkin said. "How 'accessible' and 'mineable material' and 'cost-effective' are defined by each company is to be seen."

#### Water insecurity causes hydro-political conflict escalation which goes nuclear

Harvey 8/17 [(Fiona, the Guardian's environment correspondent, won the Foreign Press Association award for Environment Story of the Year and the British Environment and Media Awards journalist of the year) “Global water crisis will intensify with climate breakdown, says report,” The Guardian, 8/17/2021] JL // recut by VS

Mark’s words should be a call to attention, and a call to action. The plight of farmers in Australia illustrates a larger reality: As planetary temperatures continue to increase and rainfall patterns shift due to human-caused climate disruption, our ability to grow crops and have enough drinking water will become increasingly challenged, and the outlook is only going to worsen. The most recent United Nations Intergovernmental Panel on Climate Change report warned of increasingly intense droughts and mass water shortages around large swaths of the globe. But even more conservative organizations have been sounding the alarm. “Water insecurity could multiply the risk of conflict,” warns one of the World Bank’s reports on the issue. “Food price spikes caused by droughts can inflame latent conflicts and drive migration. Where economic growth is impacted by rainfall, episodes of droughts and floods have generated waves of migration and spikes in violence within countries.” Meanwhile, a study published in the journal Global Environmental Change, looked at how “hydro-political issues” — including tensions and potential conflicts — could play out in countries expected to experience water shortages coupled with high populations and pre-existing geopolitical tensions. The study warned that these factors could combine to increase the likelihood of water-related tensions — potentially escalating into armed conflict in cross-boundary river basins in places around the world by 74.9 to 95 percent. This means that in some places conflict is practically guaranteed. These areas include regions situated around primary rivers in Asia and North Africa. Noted rivers include the Tigris and Euphrates, the Indus, the Nile, and the Ganges-Brahmaputra. Consider the fact that 11 countries share the Nile River basin: Egypt, Burundi, Kenya, Eritrea, Ethiopia, Uganda, Rwanda, Sudan, South Sudan, Tanzania and the Democratic Republic of Congo. All told, more than 300 million people already live in these countries, — a number that is projected to double in the coming decades, while the amount of available water will continue to shrink due to climate change. For those in the US thinking these potential conflicts will only occur in distant lands — think again. The study also warned of a very high chance of these “hydro-political interactions” in portions of the southwestern US and northern Mexico, around the Colorado River. Potential tensions are particularly worrisome in India and Pakistan, which are already rivals when it comes to water resources. For now, these two countries have an agreement, albeit a strained one, over the Indus River and the sharing of its water, by way of the 1960 Indus Water Treaty. However, water claims have been central to their ongoing, burning dispute over the Kashmir region, a flashpoint area there for more than 60 years and counting. The aforementioned treaty is now more strained than ever, as Pakistan accuses India of limiting its water supply and violating the treaty by placing dams over various rivers that flow from Kashmir into Pakistan. In fact, a 2018 report from the International Monetary Fund ranked Pakistan third among countries facing severe water shortages. This is largely due to the rapid melting of glaciers in the Himalaya that are the source of much of the water for the Indus. To provide an idea of how quickly water resources are diminishing in both countries, statistics from Pakistan’s Islamabad Chamber of Commerce and Industry from 2018 show that water availability (per capita in cubic meters per year) shrank from 5,260 in 1951, to 940 in 2015, and are projected to shrink to 860 by just 2025. In India, the crisis is hardly better. According to that country’s Ministry of Statistics (2016) and the Indian Ministry of Water Resources (2010), the per capita available water in cubic meters per year was 5,177 in 1951, and 1,474 in 2015, and is projected to shrink to 1,341 in 2025. Both of these countries are nuclear powers. Given the dire projections of water availability as climate change progresses, nightmare scenarios of water wars that could spark nuclear exchanges are now becoming possible.

## Case

#### ILaw and UN enforcement fail – 3 warrants

Adrian Taghdiri 13 [ J.D. 2013, Boston University School of Law; B.A., International Political Economy, University of California, Berkeley, 2008. "FLAGS OF CONVENIENCE AND THE COMMERCIAL SPACE FLIGHT INDUSTRY: THE INADEQUACY OF CURRENT INTERNATIONAL LAW TO ADDRESS THE OPPORTUNE REGISTRATION OF SPACE VEHICLES IN FLAG STATES " Journal of Science & Technology Law (2013), https://www.bu.edu/jostl/files/2015/02/05TaghdiriWeb.pdf, accessed 1-5-2022]//anop

As discussed above,168 none of the international space treaties enumerate procedures for enforcement of liability or the settlement of disputes.169 Rather, Article III of the Outer Space Treaty provides for the application of international law and the U.N. Charter to settle disputes relating to international space law.170 While international law and the U.N. Charter provide a significant number of dispute settlement mechanisms for disputes related to outer space, there are several deficiencies.171 First, Article III of the Outer Space Treaty implies, yet does not impose, any form of dispute settlement.172 This “extremely indirect reference” can help potentially liable states evade responsibility because of the absence of any compulsory procedures. 173 Second, even though there are references to the U.N. Charter and the International Court of Justice, it is not likely those references will be satisfactory settlement mechanisms because there is no binding obligation to submit disputes or any “inclination on the part of space-faring States to submit to the jurisdiction of the International Court.”174 Third, the laws of customary international law and of the U.N. Charter will not be capable of addressing many of the issues that will likely face the “novel, rapidly evolving field of [space] law and activity.”175

#### Space norms fail and the plan doesn’t establish consensus, it just adds a conflicting interpretation to an already fractured set of ideas about space

Dr. Steven Lambakis 18, Director of Space Studies and Senior Defense Analyst at the National Institute for Public Policy, Ph.D. at Catholic University, and Managing Editor of Comparative Strategy, “Foreign Space Capabilities: Implications for U.S. National Security”, Comparative Strategy, Volume 37, Issue 2, p. 135

A recent unclassified national security space strategy report provides no indication that the Obama Administration was preparing to actively counter the space capabilities of adversaries; rather, the Obama Administration apparently was attempting to balance its highly idealistic language with the potential realities of conflict. Yet it must be pointed out that U.S. leadership in the world today is predicated heavily on its military might. Leading by example without strength to bear against those who would transgress U.S. interests would most likely lead the nation to retreat from the defense of its interests. Moreover, such a display of weakness could lead to attacks on the United States. History does not tell us that merely leading by example through living responsibly and peacefully is the best way to defend the nation. Why would we expect this tactic to work in space? Today, counter-space operations against U.S. assets are getting attention, but there seems to be no attention given to providing the United States with capabilities to counter the hostile space activities of other nations.

There is significant discussion in official circles today about bolstering behavioral norms in space. But to whose “norms” will nations adhere? As the U.S. Deputy Assistant Secretary of Defense for Space, Doug Loverro put it, “we don’t want people shooting at satellites, we don’t believe that’s a good thing for mankind.”280 It has also been said that the establishment of norms “serves as a reminder that any battle for control over the use of space to support military operations begins well before forces begin to mobilize on Earth.”281

We cannot assume, however, that the norms which other states adopt will be those norms we deem appropriate to ensure peaceful actions and safe behavior in space. The last decade is replete with examples of other countries, some of which are potential adversaries of the United States, practicing direct ascent ASAT maneuvers; one of these was destructive, demonstrating co-orbital ASAT operations, and practicing reversible interference through jamming of radio signals or dazzling infrared sensors. The norm of self-serving behavior that advances national goals is the norm that has been most obvious in international relations for centuries. And, this norm has been reflected in space over the past 10 years. Are efforts to create benign “rules of the road” likely to replace this norm? While possible in principle, it seems extremely unlikely, and would be highly imprudent to assume as a basis for defense planning.

Another norm that characterizes the current age and should inform our thinking about space is invasion of sovereign nations. In February 2014, Russia’s president Vladimir Putin invaded Ukraine, starting with the annexation of Crimea (part of Ukraine). Since the invasion, more than 10,000 Ukrainians have been killed. This has happened despite international norms, treaties, and agreements that condemn such aggressive behavior and consider it to be politically shameful; indeed, international agreements and shaming speeches have been entirely ineffectual. The Ukrainians either did not consider that such a transgression could occur, or believed that the world would rally to their side to push back the invasion. Neither belief, of course, was based in reality. All that matters today are the facts on the ground—i.e., the nature of the regimes confronting us and the strategies they are pursuing.

There are broad national security implications of not having access to space. On land, at sea, and in the air, the United States customarily strives for peaceful, safe, and responsible behavior to avoid accidents, ensure international tensions do not flare up, and essentially collaborate with other states to ensure a stable, predictable environment—but it does so armed all the same, prepared to defend interests in each of those environments. Why? Because history is replete with violations of broken conventions and international agreements, and because peace does not last.

#### Collision is unlikely – all countries receive collision warnings THREE days ahead AND their evidence doesn’t assume new technology.

**Mosher** **’19** [Dave; September 3rd; Journalist with more than a decade of experience reporting and writing stories about space, science, and technology; Business Insider, “Satellite collisions may trigger a space-junk disaster that could end human access to orbit. Here’s How,” <https://www.usafa.edu/app/uploads/Space_and_Defense_2_3.pdf>; GR]//ww pbj

The Kessler syndrome plays center-stage in the movie "Gravity," in which an accidental space collision endangers a crew aboard a large space station. But Gossner said that type of a runaway space-junk catastrophe is unlikely. "Right now I don't think we're close to that," he said. "I'm not saying we couldn't get there, and I'm not saying we don't need to be smart and manage the problem. But I don't see it ever becoming, anytime soon, an unmanageable problem." There is no current system to remove old satellites or sweep up bits of debris in order to prevent a Kessler event. Instead, space debris is monitored from Earth, and new rules require satellites in low-Earth orbit be deorbited after 25 years so they don't wind up adding more space junk. "Our current plan is to manage the problem and not let it get that far," Gossner said. "I don't think that we're even close to needing to actively remove stuff. There's lots of research being done on that, and maybe some day that will happen, but I think that — at this point, and in my humble opinion — an unnecessary expense." A major part of the effort to prevent a Kessler event is the Space Surveillance Network (SSN). The project, led by the US military, uses 30 different systems around the world to identify, track, and share information about objects in space. Many objects are tracked day and night via a networkof radar observatories around the globe. Optical telescopes on the ground also keep an eye out, but they aren't always run by the government. "The commercial sector is actually putting up lots and lots of telescopes," Gossner said. The government pays for their debris-tracking services. Gossner said one major debris-tracking company is called Exoanalytic. It uses about 150 small telescopes set up around the globe to detect, track, and report space debris to the SSN. Telescopes in space track debris, too. Far less is known about them because they're likely top-secret military satellites. Objects detected by the government and companies get added to a catalog of space debris and checked against the orbits of other known bits of space junk. New orbits are calculated with supercomputers to see if there's a chance of any collisions. Diana McKissock, a flight lead with the US Air Force's 18th Space Control Squadron, helps track space debris for the SSN. She said the surveillance network issues warnings to NASA, satellite companies, and other groups with spacecraft, based on two levels of emergency: basic and advanced. The SSN issues a basic emergency report to the public three days ahead of a 1-in-10,000 chance of a collision. It then provides multiple updates per day until the risk of a collision passes. To qualify for such reporting, a rogue object must come within a certain distance of another object. In low-Earth orbit, that distance must be less than 1 kilometer (0.62 mile); farther out in deep space, where the precision of orbits is less reliable, the distance is less than 5 kilometers (3.1 miles). Advanced emergency reports help satellite providers see possible collisions much more than three days ahead. "In 2017, we provided data for 308,984 events, of which only 655 were emergency-reportable," McKissock told Business Insider in an email. Of those, 579 events were in low-Earth orbit (where it's relatively crowded with satellites).

#### It doesn’t go nuclear---resilience, deterrence, and low-level attacks are empirically denied.

Zack Cooper 18. Senior fellow for Asian security at the Center for Strategic and International Studies (CSIS). Thomas G. Roberts is a research assistant and program coordinator for the Aerospace Security Project at CSIS, "Deterrence in the Last Sanctuary," War on the Rocks, https://warontherocks.com/2018/01/deterrence-last-sanctuary/

Until recently, resilience in space was largely an afterthought. It was assumed that a conflict in space would likely lead to or precede a major nuclear exchange. Therefore, the focus was on cost-effective architectures that maximized satellite capabilities, often at the cost of resilience. Recently, however, some have hoped that new architectures could enhance resilience and prevent critical military operations from being significantly impeded in an attack. Although resilience can be expensive, American investments in smaller satellites and more distributed space architectures could minimize adversary incentives to carry out first strikes in space. In the late 20th century, minor escalations against space systems were treated as major events, since they typically threatened the superpowers’ nuclear architectures. Today, the proliferation of counter-space capabilities and the wide array of possible types of attacks means that most attacks against U.S. space systems are unlikely to warrant a nuclear response. It is critical that policymakers understand the likely break points in any conflict involving space systems. Strategists should explore whether the characteristics of different types of attacks against space systems create different thresholds, paying particular attention to attribution, reversibility, the defender’s awareness of an attack, the attacker’s ability to assess an attack’s effectiveness, and the risks of collateral damage (e.g., orbital debris). Competitors may attempt to use non-kinetic weapons and reversible actions to stay below the threshold that would trigger a strong U.S. response. The 2017 National Security Strategy warns: Any harmful interference with or an attack upon critical components of our space architecture that directly affects this vital U.S. interest will be met with a deliberate response at a time, place, manner, and domain of our choosing. In order to fulfill this promise, the United States will want to ensure that it has capabilities to respond both above and below various thresholds to ensure a full-spectrum of deterrence options for the full range of potential actors. In the first space age, the two superpowers had largely symmetric capabilities and interests in outer space (with a few notable exceptions). In the second space age, however, the space domain includes many disparate players with vastly different asymmetric capabilities and interests. The United States is more reliant on space than any other country in the world, but it also retains greater space capabilities than any of its competitors. Although the 2011 National Security Space Strategy states, “Space capabilities provide the United States and our allies unprecedented advantages in national decision-making, military operations, and homeland security,” this also means that that the United States has more to lose. From the dawn of the first space age, Americans understood the many benefits that could come from the peaceful uses of space and the great harm that could result from hostile uses of space. In 1962, President John F. Kennedy addressed the dilemma of how to reap the benefits of space without conflict, stating only if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new terrifying theater of war… space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours. For 60 years, space has been the exception: the one domain that has remained free from the scars of war. By better understanding the dynamics of the second space age, we may be able to keep it that way.

#### Space war would be viewed as a conventional attack---won’t go nuclear and empirically denied.

Niall Firth 19. News Editor at MIT Technology Review. "How to fight a war in space (and get away with it)". MIT Technology Review. 6-26-2019. https://www.technologyreview.com/s/613749/satellite-space-wars/

Space is so intrinsic to how advanced militaries fight on the ground that an attack on a satellite need no longer signal the opening shot in a nuclear apocalypse. As a result, “deterrence in space is less certain than it was during the Cold War,” says Todd Harrison, who heads the Aerospace Security Project at CSIS, a think tank in Washington, DC. Non-state actors, as well as more minor powers like North Korea and Iran, are also gaining access to weapons that can bloody the noses of much larger nations in space. That doesn’t necessarily mean blowing up satellites. Less aggressive methods typically involve cyberattacks to interfere with the data flows between satellites and the ground stations. Some hackers are thought to have done this already.

#### It would never happen – inability to maintain secrecy, deterrence, interdependence

Roger Handberg 17, Professor in the School of Politics, Security, and International Affairs at the University of Central Florida, 2017, “Is space war imminent? Exploring the possibility,” Comparative Strategy, Vol. 36, No. 5, p. 413-425

The assumption made is that space war will be successfully waged in both the heavens and on the Earth itself. This assumption, however, is grounded on several hypotheticals occurring. First, that total devastating strategic surprise can be achieved—the side attacked becomes so damaged and devastated that further resistance is impossible to sustain regardless of national will, since nuclear weapons overhang the entire enterprise. The analogy usually invoked for American audiences is a “Pearl Harbor” type attack. This scenario is premised on equivalent American incompetence and lack of readiness as exhibited in December 1941. One must note that Pearl Harbor ended as a strategic failure for Japan—it led to defeat because the attack mobilized U.S. power without hesitation, given the intense political divisions over whether to enter the worldwide conflicts already raging. The attack was a military failure because Navy carriers were not destroyed along with battleship row along with critical fuel facilities. Similar analogies invoke September 11, 2001 as the prototype for such attacks more recently, but the same caveats apply. Total surprise assumes that all relevant opponent systems and civilian assets are disabled and left vulnerable to follow on attacks. In fact, collapse of U.S. defenses leaves U.S. cities as hostages to the rulers of the heavens, or vice versa if the U.S. moves first. Space war is extremely destabilizing, as will be discussed, since survivability of one's strategic assets becomes problematic. Second, surprise requires that sufficient offensive space assets be placed in orbit without triggering a response by other states—the scale of such technology deployment is in itself possibly self-defeating given high costs and a likely lack of launch capacity. In addition, much launch capacity is now international rather than national, so maintaining secrecy becomes even more difficult. Space as an operational environment suffers from excessive transparency, meaning any launches can be monitored and tracked by others with strong evidence as to what is being deployed. One must remember that the original satellite launches in the 1950s were accurately tracked by a British grade-school class as a science project. In addition, at least since the early 1960s, remote sensing has increased exponentially the global capability to detect buildup of military assets of differing types, whether in space or on the ground. Commercial remote-sensing capabilities further enhance the capacity to detect militarily relevant actions. For example, commercial imagery is accessed by private parties to monitor the North Korean missile and nuclear weapons programs, in effect expanding the capacity of the world to look in on various states' interior regions, scanning for relevant information, including weapons buildup and launch capabilities. Even construction of physical facilities for production of space assets or for other weaponry can be monitored, making surprise more difficult but not impossible, as demonstrated in earlier monitoring of North Korea and, in 1998, the nuclear tests by both Pakistan and India. That means if the ASAT weapons come from ground locations, there is a high probability that they can be detected but no guarantee exists that detection will in fact occur. The uncertainty will impact calculations of attack success. Third, the most obvious initial attack of space-based assets will most likely come from cyber attacks, given that such actions do not necessarily require the scale of resources necessary for other modalities such as kinetic weapons, or even lasers or other energy-type weapons. One will have to position the weapons plus the infrastructure to permit rapid recycling of the weapons for the next attack. Firing off interceptors will likely be a one-off, meaning extremely precise targeting will be required if the attack is to be successful. Note that none of these systems require that individuals be placed in Earth orbit, despite the imagery describing such operations in fictional universes. Deployment requires a large lift capacity for initial deployment plus replenishment of destroyed or inoperative space assets, since a space conflict assumes that assets will be lost either kinetically or be compromised by cyber or energy beams. In any case, the combatants must be able to recover their capabilities lost during the conflict; failure to do would mean defeat or at least stalemate, negating the reason for the attack. That raises a major question when one considers the problem or expectation that space war can be successfully conducted or defended. Operationally Responsive Space (ORS) remains a critical weak point for all potential space-war participants. Loss of space assets occurs routinely during operations, but actual combat losses can be exponential depending on the weaponry used, and replacing those losses becomes the race to the next level after the initial exchange or combat. Unfortunately, ORS remains a major weakness of the United States and likely other states; deploying replacement satellites remains a multiyear process, while launch capabilities are scheduled long in advance. The rise of multiple private-launch competitors may partially alleviate some of the delay but that remains problematic given that the military payloads may be competing with commercial vendors also trying to replace losses. The tradeoff is that. in principle, private-launch vendors may be able to do so more cheaply, but their capacity may be saturated by demand from the civil and commercial sectors, leaving few “uncommitted” launch options for military purposes. Normally this is not an issue, but the available launch options may be third party rather than national-flag carriers, which raises severe security concerns. Fourth, several other assumptions become essential to make the strategy work, including that such an attack does not render Earth orbit so debris-saturated that further military space operations become impossible to sustain. Also, damage to civilian space assets remains, such that their continuation is possible if undamaged replacements can be quickly reintroduced to restart economically critical operations. Globalization has been fostered through satellite technologies. Their disruption can be devastating for all parties, regardless of who is the winner or the loser. What may occur is the graveyard of the modern economic system. No potential space participants would be immune to the damage, regardless of whether or not they were participants in the actual conflict. Fifth, there must be no difficulty in separating potential targets from the enemy, allied states, and nonbelligerent states. This creates a situation in which the spread of space technologies globally complicates actions, expanding the range of participants beyond the combatants, much like earlier wars at sea, where there were the combatants' ships, along with those of nonbelligerents, including neutrals whom the combatants struggled to draw into the conflict on their side, or at least to render their services unavailable to the other side. The earliest discussion of space conflict was premised on Cold War analogies, meaning two major combatants, either U.S.–Russia, or U.S–-China, or even a three-way war. Presently, analyses focus on a bilateral conflict with the U.S. opposed to China and Russia. Whether that would occur is obviously unknown, despite political rhetoric about a Eurasia coalition of likeminded states. What it does is multiply the number of potential targets and complicates reactions to neutrals' actions to protect their interests or assets. The distinction between combatants and neutrals or third parties will be possibly blurred beyond separation. The byproduct of a kinetic space conflict is massive amounts of space debris, destroying or damaging most space assets regardless of their state sponsor or nationality. Initial attacks may be focused and precise, but the result is still the same. The debris generated by armed conflict will endure beyond the immediate clash. The obvious alternative is a strictly electronic attack on space assets' operating systems, leaving the satellites in orbit, although without the ability to move them or control possible erratic changes in orbit due to collisions with other space debris. Other forms space war will take Reality is more complicated—kinetic action produces debris, the ultimate deterrent to actual space war. Therefore, space war could likely track several distinct phases. The first is cyber attacks, which disable or destroy the working systems of the spacecraft or the ground-support network—in effect, a series of stealth attacks. Civilian satellites are extremely soft targets—defense requires a capacity to detect and analyze any attack on the spacecraft, not available presently for most commercial spacecraft due to cost considerations. Otherwise, one could use nuclear weapons to create electromagnetic pulses (EMP) which can fry unprotected electronics both in space and on the ground, depending on where the weapons are detonated. Interestingly, space war scenarios have some territorial war aspects in that any attacks on space assets will devastate both military and civilian targets without distinction between the war participants and civilians. Similar to unrestricted submarine warfare, all targets in the relevant area will become casualties or otherwise impacted in their operations. Second, attacks that are conducted against the ground down links and/or communications systems, leaving the spacecraft without guidance or instructions, and also no information is returned to the commanders even if the satellites survive the initial onslaught. These can involve kinetic attacks against specific locations or insertion of special operations forces to render the facility inoperative. For example, antennas can be disabled or destroyed, disrupting operations until new facilities are brought online. Other alternatives could include kinetic weapons launched from space, “rods from God.”20 Air strike packages could include electronic warfare elements capable of scrambling or disrupting operations of such facilities even prior to physical strikes against the targets. Spacecraft not destroyed or disabled in the initial two stages of the attack can be directly attacked by “dazzling” their receivers, with laser impulses destroying the receivers for which there are few replacements without replacing the spacecraft physically. Third, rapid replacement of inoperative satellites, regardless of the reasons, does not occur, which translates into a race for the third, possibly end, phase of the war, replenishment. Inability to replace losses may mean that none of the combatants are able to dominate in the end, meaning conventional conflict may be the outcome, although issues of global reach may confine conflicts to relatively small areas. In previous conventional conflicts, large-scale forces were moved, albeit slowly, across the globe to the conflict, i.e., Desert Shield morphing into Desert Storm after a nearly six-month buildup.