## OFF

### 1NC---Regulations CP

#### Counterplan text: The Committee on the Peaceful use of Outer Space ought to

#### establish an application system for property rights on celestial bodies conditioned upon open disclosure of data and applications.

#### Private entities will only be granted one property grant per celestial body.

#### Private Entities will only mine and extract asteroids during the asteroids natural orbit.

#### CP solves the Case – A] Solves Advantage 1 because it makes mining safe and takes out the risk of collisions B] Solves Advantage 2 because the cp sets up a binding property rights regime and ensures countries have vested interest against war and for development.

#### It competes – we don’t ban private appropriation of asteroid mining and it’s an entirely new process from the affirmative.

#### Mining regulations ensure Mining is safe.

**Steffen 21** [Olaf Steffen, Olaf is a scientist at the Institute of Composite Structures and Adaptive Sytems at the German Aerospace Center. 12-2-2021, "Explore to Exploit: A Data-Centred Approach to Space Mining Regulation," Institute of Composite Structures and Adaptive Systems, German Aerospace Center, [https://www.sciencedirect.com/science/article/pii/S0265964621000515 accessed 12/12/21](https://www.sciencedirect.com/science/article/pii/S0265964621000515%20accessed%2012/12/21)] Adam

4. The data-centred approach to space mining regulation 4.1. Core description of the regulatory regime and mining rights acquisition process The data gathered in the exploration of a [celestial body](https://www.sciencedirect.com/topics/social-sciences/astronomical-systems) is not only of value for space mining companies for informing them whether, where and how to exploit resources from the body in question, but also for science. The irretrievability of information relating to the solar system contained in the body that will be lost during resource exploitation carries a value for humanity and future generations and can thus be assigned the characteristic of a common heritage for all mankind as invoked in the Moon Agreement. This characteristic makes exploration data an exceptional and unique candidate for use in a mechanism for acquiring mining rights because its preservation is of public interest and its disclosure in exchange for exclusive mining rights does not place any additional burden on the mining company. The following principles would form the cornerstones of the proposed regulatory regime and rights acquisition mechanism based on exploration data: Without preconditions, no entity has a right to mine the resources of a celestial body. An international regulatory body administers the existing rights of companies for mining a specific celestial body. Mining rights to such bodies can be applied for from this international regulatory body, with applications made public. The application expires after a pre-set period. Mining rights are granted on the provision and disclosure of exploration data on the celestial body within the pre-set period, proposedly gathered in situ, characterising this body and its resources in a pre-defined manner. The explorer's mining right to the resources of the celestial body is published by the regulatory body in a mining rights grant. The data concerning the celestial body are made public as part of the rights grant within the domain of all participating members of the regulatory regime. The exclusive mining rights to any specific body are tradeable. The scope of the regulatory body with respect to the granting of mining rights is not revenue-oriented. The international regulatory body would thus act as a curator of a rights register and an attached database of exploration data. The concept is superficially comparable to patent law, where exclusive rights are granted following the disclosure of an invention to incentivise the efforts made in the development process. In the following section, the characteristics of such a regulatory regime are further discussed with respect to the formation of [monopolies](https://www.sciencedirect.com/topics/social-sciences/monopolies), market dynamics, conflict avoidance, inclusivity towards less developed countries and the viability of implementation. 4.2. Discussion and means of implementation The proposed regulatory mechanism has advantages both from a business/investor and society perspective. First, it prevents already highly capitalised companies from acquiring exploitation rights in bulk to deny competitors those objects that are easiest to exploit or most valuable, which would otherwise be possible in any kind of pay-for-right mechanism and could result in preventing market access to smaller, emerging companies. Thus, early monopoly formation can be avoided. The use of data disclosure for the granting of mining rights ensures the scientific community has access to this invaluable source of information. In this way, space mining prospecting missions can lead to a boost in research on small celestial bodies at a speed unmatchable by pure government/agency funded science probes. This usefulness to the scientific community could lead to sustained partnerships between prospecting companies and scientific institutions and could even provide a source of funding for the companies through R&D grants and public-private partnerships. The results of the exploration efforts contribute to research on the formation of planets and the history of the solar system and provide valuable insight for space defence against asteroids. The transition of exploration from a tailored mission profile with a purpose-built spacecraft to a standard task in space flight would also lead to a cost reduction of the respective exploration spacecraft through [economies of scale](https://www.sciencedirect.com/topics/social-sciences/economies-of-scale). This describes the very benefits Elvis [[24](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib24)] and Crawford [[25](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib25)] imagined as possible effects of a space economy. Thus, there is an immediate return for society from the exploitation rights grant. It also reconciles the adverse interests of space development and [space science](https://www.sciencedirect.com/topics/social-sciences/space-sciences) as laid out by Schwartz [[26](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib26)]. It ensures that, by exploitation, information contained in celestial bodies is not lost for future generations.The application period should not be set in a manner that creates a situation that can be abused through the potential for stockpiling inventory rights. Rather, it is intended to prevent conflict in the phase before exploration data gathered by a mission, as a prerequisite to the mining rights grant, is available. In other words, only one exploration effort at a time can be permitted for a specific body. The time frame between the application and the granting of mining rights (meaning: availability of the required exploration data set) should be tight and should only consider necessary exploration time on site, transit time and possibly a reasonable launch preparation and data processing markup. These contributors to the application period make it clear that the time frame could be dynamic and individualistic, depending on the exploration target (transit time and duration of exploration) and the technology of the exploration probe (transit time). After the expiration of the application period, applications for the exploration target would again be permissible. To prevent the previously mentioned stockpiling of inventory rights, credible proof of an imminent exploration intention would need to be part of the application process, for example, a fixed launch contract or the advanced build status of the exploration probe. Such a mechanism would not contradict the statement in the OST that outer space shall be free for both exploration and scientific investigation. Applications would not apply to purely scientific exploration. An application would only be necessary as a prerequisite for mining. Even resource prospecting could take place without an application (for whatever reason), with a subsequent application comprising in situ data already gathered. For such cases, the application process would need to provide a short period for objections to enable the secretive explorer to make their efforts public. The publication of the application for the mining rights, which is nothing more than a statement of intention to explore, thus provides a strong measure for avoiding conflict. The transparency of where exploration spacecraft are located and, at a later stage, where mining activities take place, provides additional benefits for the sustainable use of space, trust building and deterrence against malign misuse of mining technology. Involuntary spacecraft collisions of competitors in deep space are prevented by the reduction of exploration efforts at the same destination through the application for mining rights by one applicant at a time. As pointed out by Newman and Williamson [[20](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib20)], this is relevant because space debris does not de-orbit in deep space as in the case of LEO. Deep space may be vast, but the velocities involved mean that small debris particles are no less dangerous. Considering NEO mining with fleets of small spacecraft, malfunctions and/or destructive events could create debris clouds crossing Earth's orbit around the sun on a regular basis, presenting another danger to satellites in Earth's own orbit. Thus, by effectively preventing the collision of two spacecraft, one source of debris creation can be mitigated through this regulation mechanism. With respect to Deudney's [[11](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib11)] scepticism of asteroid mining and the dual-use character of technology to manipulate orbits of celestial bodies, it has to be stated that this potential is truly inherent to asteroid mining. An asteroid redirect mission for scientific purposes was pursued by NASA [[49](https://www.sciencedirect.com/science/article/pii/S0265964621000515" \l "bib49)] before reorientation towards a manned lunar mission. In one way or another, each type of asteroid mining will require the delivery of the targeted resource to a destination via a comparable technology as formerly envisioned by NASA, be it as a raw material or a useable resource processed in situ, even if this is not necessarily done through redirecting the whole asteroid and placing it in a lunar orbit. However, to be misused as a weapon, space mined resources would have to surpass a certain mass threshold to survive atmospheric entry at the target. This seems unfeasible for currently discussed mining concepts using small-scale spacecraft as described in this article. Redirecting larger masses or whole asteroids would require far more powerful mining vessels or small amounts of thrust over long periods of time. The continuous, (for a mining activity) untypical change in the orbit of an asteroid would make a redirect attempt with hostile intent easily identifiable, effectively deterring such an activity in the first place by ensuring the identification of the aggressor long before the projectile hits its target. The proposed database would provide a catalogue of asteroids with exploration and mining activities in place that should be tracked more closely because of their interaction with spacecraft. This would, in fact, be necessary per se as a precaution to avoid catastrophic mishaps, such as the accidental change of a NEO's orbit to intercept Earth by changing its mass through mining.

#### Ensuring Asteroid Mining only occurs in the Asteroids Orbit solves Collisions, Debris, and Astro-Terror.

Drmola and Mareš 15 - Jakub Drmola is a PhD student and Miroslav Mareš professor, at the Divison of Security and Strategic Studies, Masaryk University, Czech Republic, "Revisiting the deflection dilemma", *Astronomy & Geophysics*, Volume 56, Issue 5, October 2015, Pages 5.15–5.18, <https://academic.oup.com/astrogeo/article/56/5/5.15/235650>

There are two basic ways to go about moving the resources contained within a given asteroid to the Earth. They can be extracted from the asteroid during its natural orbit and then transported to the Earth, or the entire asteroid might be moved closer to a more convenient location before starting mining. Thus repositioned, it might even be used as a shielded habitat, once hollowed out (Ostro 1999). There are different speculative costs and benefits associated with either option, which would vary with the size, orbit and composition of the asteroid. But, crucially, the second option would entail putting asteroids into orbit around the Earth, the Moon or possibly at one of the Earth’s Lagrangian points. Indeed, NASA has already planned a mission to capture a small asteroid and place it in a high cislunar orbit, where it would serve as a destination for future manned missions and experiments. This “Asteroid Redirect Mission” is to take place in the next decade and is being pitched mainly as a stepping stone towards a future mission to Mars (see box “NASA’s Asteroid Redirect Mission”; Brophy et al. 2012, Burchell 2014, Gates et al. 2015). Programmes to redirect asteroids and, especially, plans to mine asteroids on an industrial scale essentially resurrect the deflection dilemma. But it is no longer a matter of superpowers intentionally misusing technology designed to prevent dangerous impacts. It becomes an issue of proliferation among private entities. Once private mining companies acquire the technical ability to redirect suitable NEOs (Baoyin et al. 2011) in order to extract platinum or water from them, perilous inflections become more likely. The probability of accidents will rise with the number of asteroids whose trajectories we decide to manipulate. Such accidents might be very unlikely, but even a tiny technical or human error in the execution of an inflection meant to place an asteroid into the lunar or geocentric orbit might send it crashing into the Earth with potentially devastating consequences. And while we might find solace in the low probabilities associated with such an accident, even contemporary industries which are considered very safe suffer from unlikely tragedies. Despite being dependable and reliable, airliners do crash; there are a lot of them flying and very improbable accidents do happen if the dice are rolled often enough. Undoubtedly, we will not be steering as many asteroids as we steer planes any time soon, but industries tend to be more accident-prone during their infancy. Furthermore, a single asteroid can do a lot more damage than a single plane. And who is to say how much metal or water we are going to need in space over the course of the 21st century, or the next? The second source of risk is the intentional misuse, similar to the original deflection dilemma. But the entry barrier for asteroid weaponization gets much lower if mining them and moving them around becomes a common industrial activity. This is in stark contrast to the original scenario which envisioned this technology to be used solely for planetary defence and under control of a very small number of the most powerful countries (Morrison 2010). If such a powerful technology becomes widely and commercially available, even rogue states and wellfunded terrorist groups might be tempted to use it for an unexpected and devastating attack. In addition, an active asteroid mining industry would make it more difficult to detect any hostile inflection attempts among the number of legitimate and benign ones. Policy implications Considering these possible future dangers, it seems prudent to consider what to do about them sooner rather than later. The most obvious “solution” would be a blanket ban on the development of any technology that might lead to artificially inflected asteroids crashing into the Earth. However, such a ban would be incompatible with the dream of increased presence of humans in the solar system. It would stymie both scientific exploration and economic development here on Earth, which is increasingly dependent on precious metals and spacebased technologies. Furthermore, this approach would leave us more vulnerable to natural impacts which, in the long view, seems less than desirable. Another approach might be similar to the current regime of non-proliferation of nuclear weapons, aiming to support peaceful civilian use of nuclear power while at the same time prohibiting the spread of weapons of mass destruction. The regime mostly works (with caveats, see Wood et al. 2008) because these applications require different infrastructures and fissile materials enriched to different levels of purity. This makes it possible, at least in principle, to tell apart operations meant for the production of electricity and those designed to create weapons. Unfortunately, the difference between legitimate and hostile trajectory modification would lie only in the acceleration imparted on the asteroid and not in the technical means to do it. As the spacecraft launched with the intent to cause impact with the Earth might be identical to those sent off to retrieve resources, telling them apart would be nearly impossible, until it was too late. And this approach makes no difference to the chances of an industrial accident. If monitoring equipment on Earth is unhelpful, the focus changes to space. In other words, all asteroid movement missions should be constantly monitored. For an attacker, it would make most sense to delay the final course adjustment for as long as possible in order to give the least warning and make the timeframe for reaction as short as possible. So an asteroid might head towards a safe orbit fit for resource extraction for most of its altered flight time, but be further accelerated at the last possible moment onto an impact trajectory, perhaps mere days before it hits a major city. Our current programmes cataloguing NEOs (such as CSS or Pan-STARRS), which look for new, previously unknown objects, are not ideally suited for the task of constantly tracking a number of different, already known asteroids. New instruments would be needed to track them in order to immediately detect any hazardous inflection, whether intentional or accidental. Once such a detection is made, emergency measures to evacuate the population or, preferably, to “re-deflect” the incoming object can be executed right away, regardless of the cause. Accidents and hostilities could be treated the same way and countered by the same system (initially, at least). Such a system would be more akin to an air traffic control than a non-proliferation regulation, offering security through vigilance, rather than absence. Additionally, development of a system able to deflect incoming objects at relatively short notice would be beneficial in case of an impending natural impact. Conclusion Perhaps none of these concerns will become relevant. Maybe the idea of asteroid mining will soon fizzle out because we will discover cheaper and more efficient local alternatives. Maybe humanity will lose the will or the capability to explore space any further. Or perhaps manipulating asteroid trajectories will prove impractical or too costly. Certainly, it would not be the first time that a promising and seemingly obvious future does not come about. In the 1960s it seemed almost self-evident that by the second decade of the 21st century we would have flying cars and a base on the Moon. Yet we do not. Asteroid mining might be a similar case of unfulfilled promises and misplaced visions. On the other hand, there are examples of industries that developed surprisingly fast despite being considered unrealistic, not too long ago: air travel, nuclear power generation, or commercial satellites. The spread of the internet and the accompanying digital information revolution is another example; hardly anyone anticipated having virtually the entire repository of human knowledge at our fingertips at all times (except Douglas Adams). Whether the deflection dilemma forever remains an unmaterialized threat or it becomes a palpable problem, it is something to be mindful of now, as the foundations of the prospective asteroid mining industry are being laid. In the end, the purpose of this paper is not to predict the future. Instead it aims to merely update a conscientious warning which called for our diligence more than 20 years ago. While the world has changed somewhat, the basic idea remains valid. Whether the danger comes from warring superpowers, terrorists or negligent corporations, we must be aware of the realistic risks in order to avoid being either stumped by unforeseen catastrophes or paralysed by unwarranted fear. Either extreme would be harmful for our future.

## OFF

### 1NC---Mining Good

#### Commercial mining solves extinction from scarcity, climate, terror, war, and disease.

Pelton 17—(Director Emeritus of the Space and Advanced Communications Research Institute at George Washington University, PHD in IR from Georgetown).. Pelton, Joseph N. 2017. The New Gold Rush: The Riches of Space Beckon! Springer. Accessed 8/30/19.

Are We Humans Doomed to Extinction? What will we do when Earth’s resources are used up by humanity? The world is now hugely over populated, with billions and billions crammed into our overcrowded cities. By 2050, we may be 9 billion strong, and by 2100 well over 11 billion people on Planet Earth. Some at the United Nations say we might even be an amazing 12 billion crawling around this small globe. And over 80 % of us will be living in congested cities. These cities will be ever more vulnerable to terrorist attack, natural disaster, and other plights that come with overcrowding and a dearth of jobs that will be fueled by rapid automation and the rise of artifi cial intelligence across the global economy. We are already rapidly running out of water and minerals. Climate change is threatening our very existence. Political leaders and even the Pope have cautioned us against inaction. Perhaps the naysayers are right. All humanity is at tremendous risk. Is there no hope for the future? This book is about hope. We think that there is literally heavenly hope for humanity. But we are not talking here about divine intervention. We are envisioning a new space economy that recognizes that there is more water in the skies that all our oceans. Th ere is a new wealth of natural resources and clean energy in the reaches of outer space—more than most of us could ever dream possible. There are those that say why waste money on outer space when we have severe problems here at home? Going into space is not a waste of money. It is our future. It is our hope for new jobs and resources. The great challenge of our times is to reverse public thinking to see space not as a resource drain but as the doorway to opportunity. The new space frontier can literally open up a “gold rush in the skies.” In brief, we think there is new hope for humanity. We see a new a pathway to the future via new ventures in space. For too long, space programs have been seen as a money pit. In the process, we have overlooked the great abundance available to us in the skies above. It is important to recognize there is already the beginning of a new gold rush in space—a pathway to astral abundance. “New Space” is a term increasingly used to describe radical new commercial space initiatives—many of which have come from Silicon Valley and often with backing from the group of entrepreneurs known popularly as the “space billionaires.” New space is revolutionizing the space industry with lower cost space transportation and space systems that represent significant cost savings and new technological breakthroughs. “New Commercial Space” and the “New Space Economy” represent more than a new way of looking at outer space. These new pathways to the stars could prove vital to human survival. If one does not believe in spending money to probe the mysteries of the universe then perhaps we can try what might be called “calibrated greed” on for size. One only needs to go to a cubesat workshop, or to Silicon Valley or one of many conferences like the “Disrupt Space” event in Bremen, Germany, held in April 2016 to recognize that entrepreneurial New Space initiatives are changing everything [ 1 ]. In fact, the very nature and dimensions of what outer space activities are today have changed forever. It is no longer your grandfather’s concept of outer space that was once dominated by the big national space agencies. The entrepreneurs are taking over. The hopeful statements in this book and the hard economic and technical data that backs them up are more than a minority opinion. It is a topic of growing interest at the World Economic Forum, where business and political heavyweights meet in Davos, Switzerland, to discuss how to stimulate new patterns of global economic growth. It is even the growing view of a group that call themselves “space ethicists.” Here is how Christopher J. Newman, at the University of Sunderland in the United Kingdom has put it: Space ethicists have offered the view that space exploration is not only desirable; it is a duty that we, as a species, must undertake in order to secure the survival of humanity over the longer term. Expanding both the resource base and, eventually, the habitats available for humanity means that any expenditure on space exploration, far from being viewed as frivolous, can legitimately be rationalized as an ethical investment choice. (Newman) On the other hand there are space ethicists and space exobiologists who argue that humans have created ecological ruin on the planet—and now space debris is starting to pollute space. Th ese countervailing thoughts by the “no growth” camp of space ethicists say we have no right to colonize other planets or to mine the Moon and asteroids—or at least no right to do so until we can prove we can sustain life here on Earth for the longer term. However, for most who are planning for the new space economy the opinion of space philosophers doesn’t really fl oat their boat. Legislators, bankers, and aspiring space entrepreneurs are far more interested in the views of the super-rich capitalists called the space billionaires. A number of these billionaires and space executives have already put some very serious money into enterprises intent on creating a new pathway to the stars. No less than five billionaires with established space ventures—Elon Musk, Paul Allen, Jeff Bezos, Sir Richard Branson, and Robert Bigelow—have invested millions if not billions of dollars into commercializing space. They are developing new technologies and establishing space enterprises that can bring the wealth of outer space down to Earth. This is not a pipe dream, but will increasingly be the economic reality of the 2020s. These wealthy space entrepreneurs see major new economic opportunities. To them space represents the last great frontier for enterprising pioneers. Th us they see an ever-expanding space frontier that offers opportunities in low-cost space transportation, satellite solar power satellites to produce clean energy 24h a day, space mining, space manufacturing and production, and eventually space habitats and colonies as a trajectory to a better human future. Some even more visionary thinkers envision the possibility of terraforming Mars, or creating new structures in space to protect our planet from cosmic hazards and even raising Earth’s orbit to escape the rising heat levels of the Sun in millennia to come. Some, of course, will say this is sci-fi hogwash. It can’t be done. We say that this is what people would have said in 1900 about airplanes, rocket ships, cell phones and nuclear devices. The skeptics laughed at Columbus and his plan to sail across the oceans to discover new worlds. When Thomas Jefferson bought the Louisiana Purchase from France or Seward bought Alaska, there were plenty of naysayers that said such investment in the unknown was an extravagant waste of money. A healthy skepticism is useful and can play a role in economic and business success. Before one dismisses the idea of an impending major new space economy and a new gold rush, it might useful to see what has already transpired in space development in just the past five decades. The world’s first geosynchronous communications satellite had a throughput capability of about 500 kb / s. In contrast, today’s state of the art Viasat 2 —a half century later— has an impressive throughput of some 140 Gb/s. Th is means that the relative throughput is nearly 300,000 greater, while its lifetime is some ten times longer (Figs. 1.1 and 1.2 ). Each new generation of communications satellite has had more power, better antenna systems, improved pointing and stabilization, and an extended lifetime. And the capabilities represented by remote sensing satellites , meteorological satellites , and navigation and timing satellites have also expanded their capabilities and performance in an impressive manner. When satellite applications first started, the market was measured in millions of dollars. Today commercial satellite services exceed a quarter of a billion dollars. Vital services such as the Internet, aircraft traffi c control and management, international banking, search and rescue and much, much more depend on application satellites. Th ose that would doubt the importance of satellites to the global economy might wish to view on You Tube the video “If Th ere Were a Day Without Satellites?” [ 2 ]. Let’s check in on what some of those very rich and smart guys think about the new space economy and its potential. (We are sorry to say that so far there are no female space billionaires, but surely this, too, will come someday soon.) Of course this twenty-fi rst century breakthrough that we call the New Space economy will not come just from new space commerce. It will also come from the amazing new technologies here on Earth. Vital new terrestrial technologies will accompany this cosmic journey into tomorrow. Information technology, robotics, artificial intelligence and commercial space travel systems have now set us on a course to allow us humans to harvest the amazing riches in the skies—new natural resources, new energy, and even totally new ways of looking at the purpose of human existence. If we pursue this course steadfastly, it can be the beginning of a New Space renaissance. But if we don’t seek to realize our ultimate destiny in space, Homo sapiens can end up in the dustbin of history—just like literally millions of already failed species. In each and every one of the five mass extinction events that have occurred over the last 1.5 billion years on Earth, some 50–80 % of all species have gone the way of the T. Rex, the woolly mammoth, and the Dodo bird along with extinct ferns, grasses and cacti. On the other hand, the best days of the human race could be just beginning. If we are smart about how we go about discovering and using these riches in the skies and applying the best of our new technologies, it could be the start of a new beginning for humanity. Konstantin Tsiokovsky, the Russian astronautics pioneer, who fi rst conceived of practical designs for spaceships, famously said: “A planet is the cradle of mankind, but one cannot live in a cradle forever.” Well before Tsiokovsky another genius, Leonardo da Vinci, said, quite poetically: “Once you have tasted flight, you will forever walk the earth with your eyes turned skyward, for there you have been, and there you will always long to return.” The founder of the X-Prize and of Planetary Resources, Inc., Dr. Peter Diamandis, has much more brashly said much the same thing in quite diff erent words when he said: “The meek shall inherit the Earth. The rest of us will go to Mars.” The New Space Billionaires Peter Diamandis is not alone in his thinking. From the list of “visionaries” quoted earlier, Elon Musk, the founder of SpaceX; Sir Richard Branson, the founder of Virgin Galactic; and Paul Allen, the co-founder of Microsoft and the man who financed SpaceShipOne, the world’s first successful spaceplane have all said the future will include a vibrant new space economy. Th ey, and others, have said that we can, we should and we soon shall go into space and realize the bounty that it can offer to us. Th e New Space enterprise is today indeed being led by those so-called space billionaires , who have an exciting vision of the future. They and others in the commercial space economy believe that the exploitation of outer space may open up a new golden age of astral abundance. They see outer space as a new frontier that can be a great source of new materials, energy and various forms of new wealth that might even save us from excesses of the past. Th is gold rush in the skies represents a new beginning. We are not talking about expensive new space ventures funded by NASA or other space agencies in Europe, Japan, China or India. No, these eff orts which we and others call New Space are today being forged by imaginative and resourceful commercial entrepreneurs. Th ese twenty-fi rst century visionaries have the fortitude and zeal to look to the abundance above. New breakthroughs in technology and New Space enterprises may be able to create an “astral life raft” for humanity. Just as Columbus and the Vikings had the imaginative drive that led them to discover the riches of a new world, we now have a cadre of space billionaires that are now leading us into this New Space era of tomorrow. These bold leaders, such as Paul Allen and Sir Richard Branson, plus other space entrepreneurs including Jeff Bezos of Amazon and Blue Origin, and Robert Bigelow, Chairman of Budget Suites and Bigelow Aerospace, not only dream of their future in the space industry but also have billions of dollars in assets. These are the bright stars of an entirely new industry that are leading us into the age of New Space commerce. These space billionaires, each in their own way, are proponents of a new age of astral abundance. Each of them is launching new commercial space industries. They are literally transforming our vision of tomorrow. These new types of entrepreneurial aerospace companies—the New Space enterprises—give new hope and new promise of transforming our world as we know it today. The New Space Frontier What happens in space in the next few decades, plus corresponding new information technologies and advanced robotics, will change our world forever. These changes will redefi ne wealth, change our views of work and employment and upend almost everything we think we know about economics, wealth, jobs, and politics. Th ese changes are about truly disruptive technologies of the most fundamental kinds. If you thought the Internet, smart phones, and spandex were disruptive technologies, just hang on. You have not seen anything yet. In short, if you want to understand a transition more fundamental than the changes brought to the twentieth century world by computers, communications and the Internet, then read this book. There are truly riches in the skies. Near-Earth asteroids largely composed of platinum and rare earth metals have an incredible value. Helium-3 isotopes accessible in outer space could provide clean and abundant energy. There is far more water in outer space than is in our oceans. In the pages that follow we will explain the potential for a cosmic shift in our global economy, our ecology, and our commercial and legal systems. These can take place by the end of this century. And if these changes do not take place we will be in trouble. Our conventional petro-chemical energy systems will fail us economically and eventually blanket us with a hydrocarbon haze of smog that will threaten our health and our very survival. Our rare precious metals that we need for modern electronic appliances will skyrocket in price, and the struggle between “haves” and “have nots” will grow increasingly ugly. A lack of affordable and readily available water, natural resources, food, health care and medical supplies, plus systematic threats to urban security and systemic warfare are the alternatives to astral abundance. The choices between astral abundance and a downward spiral in global standards of living are stark. Within the next few decades these problems will be increasingly real. By then the world may almost be begging for new, out of- the-box thinking. International peace and security will be an indispensable prerequisite for exploitation of astral abundance, as will good government for all. No one nation can be rich and secure when everyone else is poor and insecure. In short, global space security and strategic space defense, mediated by global space agreements, are part of this new pathway to the future.

#### Resource scarcity coming now and causes extinction—asteroid mining is the only way to solve

Crombrugghe 18 – Guerric, Business Development Manager Brussels, Brussels Capital Region, “Asteroid mining as a necessary answer to mineral scarcity”, LinkedIn, 1/11/2018, <https://www.linkedin.com/pulse/asteroid-mining-necessary-answer-mineral-scarcity-de-crombrugghe>

We need minerals, and we always will. Yet, our reserves are finite and a 100% end-of-life recycling rate is impossible to achieve. Eventually, new entrants will therefore be required to sustain our system. While the business case for asteroid mining can obviously not be closed with current technologies, it will someday become a necessity. We may as well start preparing ourselves. Scarcity of resources, the challenge of the 21st century According to the World Bank, in 2016 humanity's growth rate was of 1.18% in terms of population, and 2.50% in terms of GDP. Both of these, in turn, drive our staggering resource consumption: there are more of us, and each of us needs more. On the other, the Earth is a closed system, and resources are only available in a finite amount. We all know by now that there is only this much oil & gas, but the same can actually be said for water, arable land, minerals, etc. These two simple observations have sparkled the debate around the scarcity of resources. Even with the best intentions, mathematics teaches us that it is impossible to indefinitely extract resources from a given finite supply [1]. The problem arising in the short-term is the exhaustion of the existing supply. That limit is actually coming in fast. In a paper published in 2007, Stephen Kessler demonstrates that the global mineral reserves are only sufficient for the next 50 years. The figure on the right shows the ratio of known global reserve to global annual consumption, given a rough indication of adequacy in years. It dates from an earlier paper, published in 1994. Since then, the development of environmental-friendly technologies (e.g. batteries, electric engines, etc.) has drastically increased the consumption rate of high-tech metals such as cobalt, platinum, rare earths, or titanium. On the other hand, exploration programs have allowed to discover new deposits, notably of gold and diamond. We will certainly be able to continue to increase - or at least sustain - our reserves, but only temporarily. Recycling and other temporary fixes An obvious solution is recycling, i.e. rejuvenating our stocks. A popular concept to illustrate this idea is that of urban mining: retrieving the ores present in smartphones and other electronic devices. It may prove to be not only more environmental-friendly, be also safer and more cost-effective. Nevertheless, every solution based on recycling is, again, nothing more than a temporary fix, buying us a finite amount of time. The United Nations Environment Programme studied in a report the current recycling rate of 60 metals. More than half of them have an end-of-life recycling rate below 1%, and less than one-third are above 50%. Nickel, for example, is relatively easy to retrieve, with and end-of-life recycling rate of up to 63% under the best conditions. At that rate, less than 1% of the initial stock is available after only 10 cycle. Even with a staggering 99% efficiency, the same 1% limit is achieved in less than 460 cycles. Not bad, of course, but still not enough. Should our hunger for resources continue, and even with the most optimised recycling techniques, a second problem will arise in the longer term: the amount of resources needed at a given time will simply exceed the total available stock. Unless we manage to find growth vectors that do not require raw materials, that tipping point is an impassable limit. Its proximity obviously depends on our consumption rate. Asteroid mining? No matter which way we look at it, we will thus be short on resources, either through sheer exhaustion (i.e. transformation in an unrecoverable form) or because the demand will exceed the total reserves. We can - and should - talk about recycling, dematerialisation, and other more ethically questionable solutions such as bio-engineering. Nonetheless, no matter how good they are, these are only temporary fixes. If we don't radically change our lifestyle, we will sooner or later have to address the elephant in the room: the Earth is a closed system, we need new entrants. How can space help? Short answer: all these minerals can be found in space. Some are difficult to obtain, others are even more difficult, none are straightforward. The most accessible destination is near-Earth asteroids, a reservoir of over 17,000 known - and counting - giant rocks that regularly cross the orbit of our planet. They are commonly classified in three main families. The most interesting one, for our case, is that of the S-type asteroids. These are metallic bodies, containing first and foremost nickel, iron and cobalt, but also gold, ores from the platinum group. But the list doesn't stop there, many other minerals can be found in smaller amounts: iridium, silver, osmium, palladium, rhenium, rhodium, ruthenium, manganese, molybdenum, aluminium, titanium, etc. How do we get there? Let's take an example: Ryugu, formerly known as 1999 JU3. It's a C-type asteroid measured to be approximately one kilometre in size [2]. In addition to nickel, iron and cobalt, it also contains a fair share of water, nitrogen, hydrogen, and ammonia. Its total value is estimated to be approximately 80 billion USD. Fantastic! But how do we get there and, most importantly, how much does it cost? Well, we may have the start of an answer to these questions. Reaching Ryugu is a technological challenge, but it is feasible. In December 2014, the Japanese space agency has launched a spacecraft, Hayabusa2, heading to the asteroid. Its mission includes the collection of a small sample which will be sent back to the Earth, with a landing planned for December 2020. The target for the sample size is at least 100 µg. The total cost of the mission was projected to be around 200 million USD. That's 2 trillion USD per gram. Let's be optimistic and assume that the sample retrieved is pure gold. At today's rate, it is worth 42.5 USD per gram. That's a difference of over 10 orders of magnitude. Some may argue that Hayabusa2 has many other objectives that retrieving a sample. The mission does indeed include multiple landers, thorough scientific investigations, etc. There is actually another asteroid sample return mission underway, which we could you as a second point of comparison: OSIRIS-Rex, from NASA. It's heading for Bennu, also a C-type asteroid, which it will reach in August 2018. Total cost of the mission: 980 million USD. Target sample size: at least 60 g. We achieve thus roughly speaking 16 million USD per gram. Better, but still 6 orders of magnitude off compared to pure gold. It's pretty much as good as it gets with existing state-of-the-art technologies. Not much of a business case. Should we forget about it? Referring back to our earlier conclusion on resource scarcity, we had two options. Either we drastically reduce our resource consumption, to such a degree that reserves can last for longer than humanity itself, or we extend our closed system, the Earth, to nearby asteroids. In the current state of affairs, I am honestly not sure which course of action is the easiest. As they get increasingly rare, the cost of minerals will go up. On the other hand, as explained in a previous article, we can expect the cost of space activities to go steadily down. Step by step, these 6 orders of magnitude will slowly get munched away from both ends, until eventually asteroid mining becomes a viable operation. In other words: it will only become financially interesting once minerals become a thousand times more expensive and space activities a thousand times cheaper. As a point of reference, the introduction of reusable rockets by SpaceX, widely considered as one of the few truly disruptive changes in the aerospace sector in the last few decades, has "only" brought a cost reduction of 30%. While it's clearly amazing, we still need at least 220 innovations of the same calibre [3] before we can make it work (again: assuming the price of minerals simultaneously goes up by a factor of a thousand). It's therefore quite likely that space mining will not take place within our lifetime [4]. How can we accelerate the process? Firstly, we can only celebrate and support the numerous private initiatives which contribute to make that reality happen, either indirectly (e.g. launchers, space systems, etc.) or directly (e.g. in-space manufacturing, lunar exploration, etc.). Shout out to all the folks who manage to keep the flame of space exploration burning while generating profit for their investors. Secondly, space agencies and other institutional actors should continue to act as promoters of pioneering mission such as Hayabusa2, OSIRIS-REx, or DART. We can only regret that the Asteroid Redirect Mission from NASA and the Asteroid Impact Mission from ESA were not funded. From my perspective, these should actually be amongst the top priorities of our space exploration agenda. Not only are they instrumental to our understanding of the solar system, but they are also essential if we want to avoid the same fate as the dinosaurs. It's a question of survival. As a bonus, they also pave the way towards cost-efficient asteroid mining. In the meantime, we might want to consume existing resources a bit more efficiently.

#### Resource Shortages Exacerbate Conflict

Wingo 13 - Dennis Wingo, Former CTO of the Orbital Recovery Corporation, Founder & CEO of Skycorp Inc, and Greentrail Energy Inc., Co-Founder & CTO of Orbital Recovery Inc. Leader of NASA's the Lunar Orbiter Image Recovery Project (LOIRP), First in history to rescue and operate a spacecraft (ISEE-3) in interplanetary space, and University of Alabama in Huntsville Consortium for Materials Development in Space Researcher At University of Alabama in Huntsville Consortium for Materials Development in Space “Commentary | The Inevitability of Extraterrestrial Mining”, *Space News*, 7/29/2013, https://spacenews.com/36511the-inevitability-of-extraterrestrial-mining/

I am honored to provide the counterpoint to my esteemed colleague Ambassador Roger Harrison’s negative contention concerning the mining of extraterrestrial materials off of planet Earth. Let’s begin with his ending: “The conclusion is inescapable, though liable to be escaped, i.e., that raw materials will never be mined in space and sold profitably within the atmosphere or anywhere else. … Asteroids will continue unvexed in their obits, and the Moon too.” I bring a different quote, from the book “Empire Express,” the story of the intercontinental railroad, from U.S. Army Lt. Zebulon Pike, for whom Pike’s Peak is named: “In various places there were tracts of many leagues, where the wind had thrown up sand in all the fanciful forms of the ocean’s rolling wave, and on which not a spear of vegetable matter existed.” Pike’s visions of sand dunes, pathless wastes and sterile soils were reported, widely read and faithfully believed by geographers. The myth became innocently embellished by subsequent visitors, especially those in the party of Maj. Stephen H. Long, who traversed the whole area in 1820. It was reported to be “an unfit residence for any but a nomad population … forever to remain the unmolested haunt of the native hunter, the bison, and the jackal.” The delicious irony is that Mr. Harrison today lives in the shadow of Pike’s Peak, and the U.S. Air Force Academy where he teaches is in the middle of the confidently prophesied unmolested haunt. When Long’s report was written, the Erie Canal across New York was five years from completion and it was another 31 years before the first railroad was completed across the state. Mr. Harrison’s technical objections are for the most part valid today for his scenario, just as objections to a railroad across the North American continent were valid in the 1820s. However, technology is being developed today that will enable extraterrestrial mining, manufacturing and development just as technology was developed that would enable the creation of the national railroad. Mr. Harrison says it is an illusion that we are running out of resources. He is correct. That is not our claim. The claim is that extraction costs of economically viable terrestrial resources are rising dramatically and may soon exceed the cost of extraction from much more plentiful extraterrestrial sources. Today rapidly advancing costs and diminishing returns are rapidly redefining mining due to diminishing ore grades. This fact is developed in a 2012 distinguished lecture by Dan Wood before the Society of Environmental Geologists, “Crucial Challenges to Discovery and Mining — Tomorrow’s Deeper Ore Bodies.” This is a vitally important issue to solve as resource conflict has been the impetus for most wars in human history. We live in a global civilization of over 7 billion people, which will expand to over 9 billion before plateauing in mid-century. While American politicians are not paying attention to what this means, the rest of the world is noticing. Gross domestic product (GDP) growth and increasing global resource demand are addressed in “Iron Ore Outlook 2050,” a report commissioned for the Indian government. The GDP of the major powers (the United States, Europe, China, India and Japan) is forecast to rise from $48 trillion in 2010 to $149 trillion by 2050. The report’s substance is that with this massive increase in global GDP, an intensifying scramble for metal resources is inevitable. If the trend of resource consumption demand increase continues unabated, there are three likely potential outcomes. The first is collapse, forecast by the “Limits to Growth” school of thought. The second and more likely scenario is fierce national economic competition leading to wars over diminishing resources. The third, and most desirable, is to increase the global resource base by the economic and industrial development of the inner solar system. Mr. Harrison uses cost as the primary reason that extraterrestrial mining will never happen by focusing on a straw man argument related to mining asteroids in orbits far from Earth. Just as the U.S. railroad infrastructure began on shorter routes with lower capital requirements and shorter payback periods, asteroid mining can begin with our nearest neighbor, the Moon, where telepresence robotics, high-bandwidth communications and a short three-day trip for humans negate his premise. We know from the Apollo samples that plentiful metallic asteroidal materials exist in the lunar highlands. We also know from several missions that extensive water, titanium, thorium, uranium, aluminum and native iron all exist on the Moon, in easily separable oxide form. Improvements in remote sensing data from current missions and computer modeling continue to increase the amount of potential asteroidal material on the Moon, increasing confidence in the Moon first premise. The extensive resources of the Moon become the catalyst for an inner solar system-wide economy providing fuel, vehicles and the all-important experience in developing an industrial infrastructure off planet. The asteroids then become the force multiplier of inner solar system development with billions of tons of water, metals and free space energy from solar power. Mars figures in here as well as the second home of humanity, creating further demand for asteroidal resources, and providing something else that is becoming increasingly scarce on the Earth: hope for the future. The technical barriers that Mr. Harrison points to are being overcome just as those of the 19th century were. New technology developments in 3-D printing, additive manufacturing and advanced robotics are breaking down the final barriers to exploiting off-planet resources and indeed the industrial development of the inner solar system. It is not a question if, it is a question of when, and by whom. Just as the Pacific Railway Act of 1862 was a primary catalyst for a century of American economic growth, it should be the role of government to develop policies and concrete legislation to support this development for the continued health of the American economy and the future of all mankind.

#### Those Conflicts go Nuclear

Klare 13 – Michael T., professor emeritus of peace and world-security studies at Hampshire College and senior visiting fellow at the Arms Control Association in Washington, DC, " How Resource Scarcity and Climate Change Could Produce a Global Explosion", *The Nation*, 4/22/2013, <https://www.thenation.com/article/how-resource-scarcity-and-climate-change-could-produce-global-explosion/> JHW

Resource Shortages and Resource Wars Start with one simple given: the prospect of future scarcities of vital natural resources, including energy, water, land, food and critical minerals. This in itself would guarantee social unrest, geopolitical friction and war. It is important to note that absolute scarcity doesn’t have to be on the horizon in any given resource category for this scenario to kick in. A lack of adequate supplies to meet the needs of a growing, ever more urbanized and industrialized global population is enough. Given the wave of extinctions that scientists are recording, some resources—particular species of fish, animals and trees, for example—will become less abundant in the decades to come, and may even disappear altogether. But key materials for modern civilization like oil, uranium and copper will simply prove harder and more costly to acquire, leading to supply bottlenecks and periodic shortages. Oil—the single most important commodity in the international economy—provides an apt example. Although global oil supplies may actually grow in the coming decades, many experts doubt that they can be expanded sufficiently to meet the needs of a rising global middle class that is, for instance, expected to buy millions of new cars in the near future. In its 2011 World Energy Outlook, the International Energy Agency claimed that an anticipated global oil demand of 104 million barrels per day in 2035 will be satisfied. This, the report suggested, would be thanks in large part to additional supplies of “unconventional oil” (Canadian tar sands, shale oil and so on), as well as 55 million barrels of new oil from fields “yet to be found” and “yet to be developed.” However, many analysts scoff at this optimistic assessment, arguing that rising production costs (for energy that will be ever more difficult and costly to extract), environmental opposition, warfare, corruption and other impediments will make it extremely difficult to achieve increases of this magnitude. In other words, even if production manages for a time to top the 2010 level of 87 million barrels per day, the goal of 104 million barrels will never be reached and the world’s major consumers will face virtual, if not absolute, scarcity. Water provides another potent example. On an annual basis, the supply of drinking water provided by natural precipitation remains more or less constant: about 40,000 cubic kilometers. But much of this precipitation lands on Greenland, Antarctica, Siberia and inner Amazonia where there are very few people, so the supply available to major concentrations of humanity is often surprisingly limited. In many regions with high population levels, water supplies are already relatively sparse. This is especially true of North Africa, Central Asia and the Middle East, where the demand for water continues to grow as a result of rising populations, urbanization and the emergence of new water-intensive industries. The result, even when the supply remains constant, is an environment of increasing scarcity. Wherever you look, the picture is roughly the same: supplies of critical resources may be rising or falling, but rarely do they appear to be outpacing demand, producing a sense of widespread and systemic scarcity. However generated, a perception of scarcity—or imminent scarcity—regularly leads to anxiety, resentment, hostility and contentiousness. This pattern is very well understood, and has been evident throughout human history. In his book Constant Battles, for example, Steven LeBlanc, director of collections for Harvard’s Peabody Museum of Archaeology and Ethnology, notes that many ancient civilizations experienced higher levels of warfare when faced with resource shortages brought about by population growth, crop failures or persistent drought. Jared Diamond, author of the bestseller Collapse, has detected a similar pattern in Mayan civilization and the Anasazi culture of New Mexico’s Chaco Canyon. More recently, concern over adequate food for the home population was a significant factor in Japan’s invasion of Manchuria in 1931 and Germany’s invasions of Poland in 1939 and the Soviet Union in 1941, according to Lizzie Collingham, author of The Taste of War. Although the global supply of most basic commodities has grown enormously since the end of World War II, analysts see the persistence of resource-related conflict in areas where materials remain scarce or there is anxiety about the future reliability of supplies. Many experts believe, for example, that the fighting in Darfur and other war-ravaged areas of North Africa has been driven, at least in part, by competition among desert tribes for access to scarce water supplies, exacerbated in some cases by rising population levels. “In Darfur,” says a 2009 report from the UN Environment Programme on the role of natural resources in the conflict, “recurrent drought, increasing demographic pressures, and political marginalization are among the forces that have pushed the region into a spiral of lawlessness and violence that has led to 300,000 deaths and the displacement of more than two million people since 2003.” Anxiety over future supplies is often also a factor in conflicts that break out over access to oil or control of contested undersea reserves of oil and natural gas. In 1979, for instance, when the Islamic revolution in Iran overthrew the Shah and the Soviets invaded Afghanistan, Washington began to fear that someday it might be denied access to Persian Gulf oil. At that point, President Jimmy Carter promptly announced what came to be called the Carter Doctrine. In his 1980 State of the Union Address, Carter affirmed that any move to impede the flow of oil from the Gulf would be viewed as a threat to America’s “vital interests” and would be repelled by “any means necessary, including military force.” In 1990, this principle was invoked by President George H.W. Bush to justify intervention in the first Persian Gulf War, just as his son would use it, in part, to justify the 2003 invasion of Iraq. Today, it remains the basis for US plans to employ force to stop the Iranians from closing the Strait of Hormuz, the strategic waterway connecting the Persian Gulf to the Indian Ocean through which about 35 percent of the world’s seaborne oil commerce passes. Recently, a set of resource conflicts have been rising toward the boiling point between China and its neighbors in Southeast Asia when it comes to control of offshore oil and gas reserves in the South China Sea. Although the resulting naval clashes have yet to result in a loss of life, a strong possibility of military escalation exists. A similar situation has also arisen in the East China Sea, where China and Japan are jousting for control over similarly valuable undersea reserves. Meanwhile, in the South Atlantic Ocean, Argentina and Britain are once again squabbling over the Falkland Islands (called Las Malvinas by the Argentinians) because oil has been discovered in surrounding waters. By all accounts, resource-driven potential conflicts like these will only multiply in the years ahead as demand rises, supplies dwindle and more of what remains will be found in disputed areas. In a 2012 study titled Resources Futures, the respected British think-tank Chatham House expressed particular concern about possible resource wars over water, especially in areas like the Nile and Jordan River basins where several groups or countries must share the same river for the majority of their water supplies and few possess the wherewithal to develop alternatives. “Against this backdrop of tight supplies and competition, issues related to water rights, prices, and pollution are becoming contentious,” the report noted. “In areas with limited capacity to govern shared resources, balance competing demands, and mobilize new investments, tensions over water may erupt into more open confrontations.” Heading for a Resource-Shock World Tensions like these would be destined to grow by themselves because in so many areas supplies of key resources will not be able to keep up with demand. As it happens, though, they are not “by themselves.” On this planet, a second major force has entered the equation in a significant way. With the growing reality of climate change, everything becomes a lot more terrifying. Normally, when we consider the impact of climate change, we think primarily about the environment—the melting Arctic ice cap or Greenland ice shield, rising global sea levels, intensifying storms, expanding desert and endangered or disappearing species like the polar bear. But a growing number of experts are coming to realize that the most potent effects of climate change will be experienced by humans directly through the impairment or wholesale destruction of habitats upon which we rely for food production, industrial activities or simply to live. Essentially, climate change will wreak its havoc on us by constraining our access to the basics of life: vital resources that include food, water, land and energy. This will be devastating to human life, even as it significantly increases the danger of resource conflicts of all sorts erupting. We already know enough about the future effects of climate change to predict the following with reasonable confidence: \* Rising sea levels will in the next half-century erase many coastal areas, destroying large cities, critical infrastructure (including roads, railroads, ports, airports, pipelines, refineries and power plants) and prime agricultural land. \* Diminished rainfall and prolonged droughts will turn once-verdant croplands into dust bowls, reducing food output and turning millions into “climate refugees.” \* More severe storms and intense heat waves will kill crops, trigger forest fires, cause floods and destroy critical infrastructure. No one can predict how much food, land, water and energy will be lost as a result of this onslaught (and other climate-change effects that are harder to predict or even possibly imagine), but the cumulative effect will undoubtedly be staggering. In Resources Futures, Chatham House offers a particularly dire warning when it comes to the threat of diminished precipitation to rain-fed agriculture. “By 2020,” the report says, “yields from rain-fed agriculture could be reduced by up to 50%” in some areas. The highest rates of loss are expected to be in Africa, where reliance on rain-fed farming is greatest, but agriculture in China, India, Pakistan and Central Asia is also likely to be severely affected. Heat waves, droughts and other effects of climate change will also reduce the flow of many vital rivers, diminishing water supplies for irrigation, hydro-electricity power facilities and nuclear reactors (which need massive amounts of water for cooling purposes). The melting of glaciers, especially in the Andes in Latin America and the Himalayas in South Asia, will also rob communities and cities of crucial water supplies. An expected increase in the frequency of hurricanes and typhoons will pose a growing threat to offshore oil rigs, coastal refineries, transmission lines and other components of the global energy system. The melting of the Arctic ice cap will open that region to oil and gas exploration, but an increase in iceberg activity will make all efforts to exploit that region’s energy supplies perilous and exceedingly costly. Longer growing seasons in the north, especially Siberia and Canada’s northern provinces, might compensate to some degree for the desiccation of croplands in more southerly latitudes. However, moving the global agricultural system (and the world’s farmers) northward from abandoned farmlands in the United States, Mexico, Brazil, India, China, Argentina and Australia would be a daunting prospect. It is safe to assume that climate change, especially when combined with growing supply shortages, will result in a significant reduction in the planet’s vital resources, augmenting the kinds of pressures that have historically led to conflict, even under better circumstances. In this way, according to the Chatham House report, climate change is best understood as a “threat multiplier…a key factor exacerbating existing resource vulnerability” in states already prone to such disorders. Like other experts on the subject, Chatham House’s analysts claim, for example, that climate change will reduce crop output in many areas, sending global food prices soaring and triggering unrest among those already pushed to the limit under existing conditions. “Increased frequency and severity of extreme weather events, such as droughts, heat waves and floods, will also result in much larger and frequent local harvest shocks around the world….These shocks will affect global food prices whenever key centers of agricultural production area are hit—further amplifying global food price volatility.” This, in turn, will increase the likelihood of civil unrest. When, for instance, a brutal heat wave decimated Russia’s wheat crop during the summer of 2010, the global price of wheat (and so of that staple of life, bread) began an inexorable upward climb, reaching particularly high levels in North Africa and the Middle East. With local governments unwilling or unable to help desperate populations, anger over impossible-to-afford food merged with resentment toward autocratic regimes to trigger the massive popular outburst we know as the Arab Spring. Many such explosions are likely in the future, Chatham House suggests, if current trends continue as climate change and resource scarcity meld into a single reality in our world. A single provocative question from that group should haunt us all: “Are we on the cusp of a new world order dominated by struggles over access to affordable resources?” For the US intelligence community, which appears to have been influenced by the report, the response was blunt. In March, for the first time, Director of National Intelligence James R. Clapper listed “competition and scarcity involving natural resources” as a national security threat on a par with global terrorism, cyberwar and nuclear proliferation. “Many countries important to the United States are vulnerable to natural resource shocks that degrade economic development, frustrate attempts to democratize, raise the risk of regime-threatening instability, and aggravate regional tensions,” he wrote in his prepared statement for the Senate Select Committee on Intelligence. “Extreme weather events (floods, droughts, heat waves) will increasingly disrupt food and energy markets, exacerbating state weakness, forcing human migrations, and triggering riots, civil disobedience, and vandalism.” There was a new phrase embedded in his comments: “resource shocks.” It catches something of the world we’re barreling toward, and the language is striking for an intelligence community that, like the government it serves, has largely played down or ignored the dangers of climate change. For the first time, senior government analysts may be coming to appreciate what energy experts, resource analysts and scientists have long been warning about: the unbridled consumption of the world’s natural resources, combined with the advent of extreme climate change, could produce a global explosion of human chaos and conflict. We are now heading directly into a resource-shock world.

## Collisions ADV

### 1NC---Debris D

#### Even in the worst case collision risk is tiny.

Fange 17 Daniel Von Fange 17, Web Application Engineer, Founder and Owner of LeanCoder, Full Stack, Polyglot Web Developer, “Kessler Syndrome is Over Hyped”, 5/21/2017, http://braino.org/essays/kessler\_syndrome\_is\_over\_hyped/

The orbital area around earth can be broken down into four regions. Low LEO - Up to about 400km. Things that orbit here burn up in the earth’s atmosphere quickly - between a few months to two years. The space station operates at the high end of this range. It loses about a kilometer of altitude a month and if not pushed higher every few months, would soon burn up. For all practical purposes, Low LEO doesn’t matter for Kessler Syndrome. If Low LEO was ever full of space junk, we’d just wait a year and a half, and the problem would be over. High LEO - 400km to 2000km. This where most heavy satellites and most space junk orbits. The air is thin enough here that satellites only go down slowly, and they have a much farther distance to fall. It can take 50 years for stuff here to get down. This is where Kessler Syndrome could be an issue. Mid Orbit - GPS satellites and other navigation satellites travel here in lonely, long lives. The volume of space is so huge, and the number of satellites so few, that we don’t need to worry about Kessler here. GEO - If you put a satellite far enough out from earth, the speed that the satellite travels around the earth will match the speed of the surface of the earth rotating under it. From the ground, the satellite will appear to hang motionless. Usually the geostationary orbit is used by big weather satellites and big TV broadcasting satellites. (This apparent motionlessness is why satellite TV dishes can be mounted pointing in a fixed direction. You can find approximate south just by looking around at the dishes in your northern hemisphere neighborhood.) For Kessler purposes, GEO orbit is roughly a ring 384,400 km around. However, all the satellites here are moving the same direction at the same speed - debris doesn’t get free velocity from the speed of the satellites. Also, it’s quite expensive to get a satellite here, and so there aren’t many, only about one satellite per 1000km of the ring. Kessler is not a problem here. How bad could Kessler Syndrome in High LEO be? Let’s imagine a worst case scenario. An evil alien intelligence chops up everything in High LEO, turning it into 1cm cubes of death orbiting at 1000km, spread as evenly across the surface of this sphere as orbital mechanics would allow. Is humanity cut off from space? I’m guessing the world has launched about 10,000 tons of satellites total. For guessing purposes, I’ll assume 2,500 tons of satellites and junk currently in High LEO. If satellites are made of aluminum, with a density of 2.70 g/cm3, then that’s 839,985,870 1cm cubes. A sphere for an orbit of 1,000km has a surface area of 682,752,000 square KM. So there would be one cube of junk per .81 square KM. If a rocket traveled through that, its odds of hitting that cube are tiny - less than 1 in 10,000.

#### Uncertainty from debris collisions creates restraint not instability.

MacDonald 16, B., et al. "Crisis stability in space: China and other challenges." Foreign Policy Institute. Washington, DC (2016). (senior director of the Nonproliferation and Arms Control Project with the Center for Conflict Analysis and Prevention)//Elmer

In any crisis that threatens to escalate into major power conflict, political and military leaders will face uncertainty about the effectiveness of their plans and decisions. This uncertainty will be compounded when potential conflict extends to the space and cyber domains, where weapon effectiveness is largely untested and uncertain, infrastructure interdependencies are unclear, and damaging an adversary could also harm oneself or one’s allies. Unless the stakes become very high, no country will likely want to gamble its well-being in a “single cosmic throw of the dice,” in Harold Brown’s memorable phrase. 96 The novelty of space and cyber warfare, coupled with risk aversion and worst-case assessments, could lead space adversaries into a situation of what can be called “hysteresis,” where each adversary is restrained by its own uncertainty of success. This is conceptually shown in Figures 1 and 2 for offensive counter-space capabilities, though it applies more generally. 97 These graphs portray the hypothetical differences between perceived and actual performance capabilities of offensive counter-space weapons, on a scale from zero to one hundred percent effectiveness. Where uncertainty and risk aversion are absent for two adversaries, no difference would exist between the likely performance of their offensive counter-space assets and their confidence in the performance of those weapons: a simple, straight-line correlation would exist, as in Figure 1. The more interesting, and more realistic, case is notionally presented in Figure 2, which assumes for simplicity that the offensive capabilities of each adversary are comparable. In stark contrast to the case of Figure 1, uncertainty and risk aversion are present and become important factors. Given the high stakes involved in a possible large-scale attack against adversary space assets, a cautious adversary is more likely to be conservative in estimating the effectiveness of its offensive capabilities, while more generously assessing the capabilities of its adversary. Thus, if both side’s weapons were 50% effective and each side had a similar level of risk aversion, each may conservatively assess its own capabilities to be 30% effective and its adversary’s weapons to be 70% effective. Likewise, if each side’s weapons were 25% effective in reality, each would estimate its own capabilities to be less than 25% effective and its adversary’s to be more than 25% effective, and so on. In Figure 2, this difference appears, in oversimplified fashion, as a gap that represents the realistic worry that a country’s own weapons will under-perform while its adversary’s weapons will over-perform in terms of effectiveness. If both countries face comparable uncertainty and exhibit comparable risk aversion, each may be deterred from initiating an attack by its unwillingness to accept the necessary risks. This gap could represent an “island of stability,” as shown in Figure 2. In essence, given the enormous stakes involved in a major strike against the adversary’s space assets, a potential attacker will likely demonstrate some risk aversion, possessing less confidence in an attack’s effectiveness. It is uncertain how robust this hysteresis may prove to be, but the phenomenon may provide at least some stabilizing influence in a crisis. In the nuclear domain, the immediate, direct consequences of military use, including blast, fire, and direct radiation effects, were appreciated at the outset. Nonetheless, significant uncertainty and under-appreciation persisted with regard to the collateral, indirect, and climatological effects of using such weapons on a large scale. In contrast, the immediate, direct effects of major space conflict are not well understood, and potential indirect and interdependent effects are even less understood. Indirect effects of large-scale space and cyber warfare would be virtually impossible to confidently calculate, as the infrastructures such warfare would affect are constantly changing in design and technology. Added to this is a likely anxiety that if an attack were less successful than planned, a highly aggrieved and powerful adversary could retaliate in unanticipated ways, possibly with highly destructive consequences. As a result, two adversaries facing potential conflict may lack confidence both in the potential effectiveness of their own attacks and in the ineffectiveness of any subsequent retaliation. Such mutual uncertainty would ultimately be stabilizing, though probably not particularly robust. This is reflected in Figure 2, where each side shows more caution than the technical effectiveness of its systems may suggest. Each curve notionally represents one state’s confidence in its offensive counter-space effectiveness relative to their actual effectiveness. Until true space asset resilience becomes a trusted feature of space architectures, deterrence by risk aversion, and cross-domain deterrence, may be the only means for deterrence to function in space.

#### Active debris removal coming now – solves debris

**Chow 18** [Brian G. - PhD in physics from Case Western Reserve University, “Space Arms Control: A Hybrid Approach,” p. 115, *Strategic Studies Quarterly*, Volume 12, Number 2, JSTOR]

There are three reasons the United States **should not attempt to ban debris removal** and servicing spacecraft to deal with space stalking threat. First, ADR spacecraft are necessary in the emerging era **to prevent the space debris population from increasing and hindering the peaceful uses of space.** Also, as space technologies continue to become more capable and less expensive, it is highly advantageous to have some satellite services performed in space. Second, as noted earlier, China will likely deploy both ADR and OOS spacecraft in the early 2020s and Russia is likely to follow suit in the 2020s. Even if the United States wanted to delay ADR and OOS deployment for the benefit of preventing space stalker threat, it could not dissuade China and Russia from such a deployment. Third, and most importantly, there is a way to both deter and defend against space stalkers and still be able to benefit from the presence of ADR and OOS spacecraft.

#### Even full-scale escalation over debris war won’t trigger Kessler – modelling

**Drmola and Hubik 18** [Jakub Drmola, Division of Security and Strategic Studies, Department of Political Science at the Faculty of Social Sciences of Masaryk University, AND Tomas Hubik, Department of Theoretical Computer Science and Mathematical Logic, Faculty of Mathematics and Physics, Charles University, Kessler Syndrome: System Dynamics Model. Space Policy Volumes 44–45, August 2018, <https://www.sciencedirect.com/science/article/pii/S0265964617300966?via%3Dihub>]

The probabilities and rates of collisions of objects from different groups were calculated using a coefficient converting the rate of collisions between objects from one group to the rate of collisions between objects from another group. The initial base rate was estimated using iterative simulations and comparison of the resulting runs with real data and outputs from other models. Detailed model built by a group of researchers from the Lawrence Livermore National Laboratory was used as a base for the calibration [see 9]. As the major factor influencing collision probability is size, the probability increases with square of the diameter representing bigger area for possible impact. Speed would be another factor influencing the probability of impacts, but the speed depends on the distance from the Earth and is not influenced by debris size. It means that it will not vary between different debris groups and thus will not influence the collision probability conversion parameters in our model. One the most important limitations and simplifications of the model is the uncertainty of size, structure, and composition of the satellites—i.e. what debris the satellite will disintegrate into in case of a collision. Perhaps even more crucially, the rate of orbital decay changes significantly with the altitude and eccentricity of the trajectory. The lower the orbital altitude is or the more eccentric it is, the more drag the object experiences as it passes through the last vestiges of our atmosphere. Therefore, objects in the lower or more eccentric orbit will decay significantly faster. Thus, the actual lifetime of a piece of debris can easily vary from days to centuries. It also needs to be noted that while it may take many decades for a satellite to decay (especially from the popular orbits between 500 km and 800 km), we cannot assume the same about debris. That is because while satellite orbits typically have very low eccentricity, collisions result in fragments with velocities and trajectories that vary and differ from the original intact satellite (i.e. are more eccentric and decay faster). This makes estimating rate of orbital decay of debris quite difficult, especially when combined with the ongoing laudable efforts by Inter-Agency Space Debris Coordination Committee (IADC) to shorten the lifetime of satellites after they cease planned operations [14], [15]. Therefore, both the orbital and structural parameters used here are (and must be) overall averages designed to represent a “general LEO satellite” and are based on previous fragmentations, of which there are but few. Furthermore, this is getting increasingly more difficult as satellites are getting progressively more diverse, especially with the ongoing boom of the miniaturized CubeSats [16]. This leads to a relatively wide and heterogeneous population of real satellites being represented by a single, homogenized stock of simulated satellites in the model. It is also uncertain and difficult to predict how exactly is this going to evolve in the far future, what proportion of launched satellites will be of which size, and into which orbit they will be placed. Lacking precise information, we simply extrapolate current and expected trends. 5. Scenarios and simulation results 5.1. Business as usual and beyond The baseline scenario represents a continuation of the current trends, which are simply extended into the future. An average 1% growth rate of yearly launches of new satellites (starting at 89) is assumed, together with constant success rate in satellites’ ability to actively avoid collisions with debris and other satellites, constant lifetime, and failure rate. This basic model lacks any sudden events or major policy changes that would markedly influence the debris propagation. However, it serves both as a foundation for all the following scenarios and as a basis of comparison to see what the impact would be. Given high uncertainty regarding future state of the satellite industry (how many satellites will be launched per year, of what type and size, etc.), we elected to limit our simulations to 50 years. The model can certainly continue beyond this point, but the associated unknowns make the simulations progressively less useful. Running this model for its full 50 years (2016–2066) yields the expected result of perpetually growing amount of debris in the LEO. One can observe nearly 2-fold increase in the large debris (over 10 cm) and 3-fold increase in small debris (less than 1 cm) quantities (Fig. 5). The oscillations visible in the graph are caused by the aforementioned solar cycles which influence the rate of reentry for all simulated populations except the still active (i.e. powered) satellites. Also please note that throughout the article, the graphs use quite different scales for debris populations because of the considerable variations between scenarios. Using any single scale for all graphs would render some of them unintelligible. We can see that this increase in numbers still does not result in realization of the Kessler syndrome as most of the satellites being launched remain intact for their full expected service life. However, it comes with a considerable increase in risk to satellites, which is manifested by their higher yearly losses, making satellites operations riskier and more expensive for governments and private companies alike. This increased amount of debris in LEO combined with the larger number of active satellites makes it approximately twice as likely that an active satellite will suffer a disabling hit or a total disintegration during its lifetime. It should be noted that this risk might possibly be offset by future improvements in satellite reliability, debris tracking, and navigation [17]. This negative development of increasingly risky and costly operation of satellites can also be highlighted and visualized in a graph by comparing the number of satellites launched to the number of satellites lost (to collisions as well as malfunctions) in each given year (Fig. 6). This ratio shows diminishing efficiency of the system, where number of losses per launch increases. After fully acknowledging limitations stemming from inherent uncertainties, we can also try to “make things expectedly worse” by doubling the growth rate of yearly launches (to what it perhaps might end up being because of the boom in satellites industry because of increasing privatization of space, growing demand for communication satellites, etc.) and also extending the simulation timeframe to 200 years (Fig. 7). It must be stressed that the model was not designed with such long outlooks in mind, and many of the assumptions will certainly not hold over the next 200 years (such as static launch rate growth, size, and structure of the satellites, their lifetime, evasion rates, lack of mitigation, and many others). But in the overwhelmingly unlikely case that these assumptions stay true, the simulated outcome seems to suggest a collapse of sorts around the year 2163. However, it does not look like a suddenly triggered chain reaction leading to widespread fragmentation of the entire LEO but rather like a gradually reached point at which LEO is so full of debris, and the rate of active satellite fragmentation is so high (almost one every day) that the launches cannot keep up anymore. This is consistent with the findings reported by LaFleur and Finkelman, who found the debris system to be unconditionally stable [18], [19], [27]. 5.2. Antisatellite weapon system scenario Apart from the usual collisional risks that satellites face in the LEO, there has been growing concern regarding the development of antisatellite weapon systems (ASATs) by several world powers (namely China, Russian Federation, and the United States). These weapons are designed to intercept and destroy orbiting satellites and are, for the most part, descended from the antiballistic missile defense systems. While there are some alternative designs under development, the current generation mostly takes form of a boosted missile with a kinetic kill vehicle. This method of destruction (a collision of a missile with a satellite) leads to extensive fragmentation and creation of large debris clouds. A prime example of this was the Chinese 2007 ASAT test which destroyed China's own decommissioned weather satellite FengYun-1C. This hypervelocity collision created around 3000 pieces of medium to large debris and tens of thousands of smaller pieces, most of which will remain in orbit for decades, thus considerably contributing to overall risk of future orbital collisions [20]. As much as occasional tests of ASATs are increasing the amount of debris in the LEO, a greater danger by far is the possibility of a large-scale ASAT deployment during an armed conflict between two or more major, technologically advanced powers. Given the reliance of modern militaries on satellites for intelligence, communication, and navigation, it is generally presumed that the initial phase of any such conflict would involve mutual destruction of each other's satellites to blind the enemy and hinder their offensive operations [21], [22]. Such opening salvos could involve immediate destruction of dozens of satellites, thus creating massive clouds of debris threatening the remaining satellites and possibly leading to cascading disintegration across the entire orbit. This kind of hypothetical event is simulated in the second scenario, where an imaginary major military conflict erupts in the year 2040, during which roughly half of all military satellites are destroyed by intentional kinetic impacts using antisatellite weapons. With military and dual-use satellites generally representing a little over one-third of all satellites [23] (depending on criteria and the operating country), this results in some 200 satellites destroyed by ASATs in 2040 (Fig. 8). However, even this sudden event is not enough to trigger a chain reaction of satellites disintegrating in LEO, at least according to this model. Nevertheless, the number of collisions with active satellites ends up nearly twice as high at the end of the simulation (i.e. 25 years after the conflict and ASAT strikes) when compared to the previous run. This shows that the damage would be long-term and would negatively affect satellite operations (including commercial and scientific ones) for many years after any conflict involving ASATs.

#### Doesn’t go nuclear.

Zarybnisky 18 [Eric J. Zarybnisky, MA in National Security Studies from the Naval War College, PhD in Operations Research from the MIT Sloan School of Management, Lt Col, USAF. Celestial Deterrence: Deterring Aggression in the Global Commons of Space. March 28, 2018. <https://apps.dtic.mil/dtic/tr/fulltext/u2/1062004.pdf>]

PREVENTING AGGRESSION IN SPACE

While deterrence and the Cold War are strongly linked in the public’s mind through the nuclear standoff between the United States and the Soviet Union, the fundamentals of deterrence date back millennia and deterrence remains relevant. Thucydides alludes to the concept of deterrence in his telling of the Peloponnesian War when he describes rivals seeking advantages, such as recruiting allies, to dissuade an adversary from starting or expanding a conflict.6F 6 Aggression in space was successfully avoided during the Cold War because both sides viewed an attack on military satellites as highly escalatory, and such an action would likely result in general nuclear war.7F 7 In today’s more nuanced world, attacking satellites, including military satellites, does not necessarily result in nuclear war. For instance, foreign countries have used highpowered lasers against American intelligence-gathering satellites8F 8 and the United States has been reluctant to respond, let alone retaliate with nuclear weapons. This shift in policy is a result of the broader use of gray zone operations, to which countries struggle to respond while limiting escalation. Beginning with the fundamentals of deterrence illuminates how it applies to prevention of aggression in space.

### 1NC--- Multilateralism D

#### Space Multilateralism fails – free-riding.

Knopf 18 - professor at the Middlebury Institute of International Studies at Monterey, chair of the M.A. program in Nonproliferation and Terrorism Studies (Jeffrey, After diffusion: Challenges to enforcing nonproliferation and disarmament norms, *Contemporary Security Policy*, Vol. 39, Issue 3, February 9th, pages 367-398)

A second challenge that **complicates efforts to enforce** international **norms** is the well-known **collective action problem** (Olson, 1965). In many cases, effective enforcement will require the participation of more than one actor. Unless one state has unusual economic leverage, for example, economic sanctions usually **require multilateral enforcement** to be effective. Otherwise, the target state can evade sanctions by trading with those states that choose not to participate in the sanctions effort. **Even military enforcement** often **depends on** the involvement of **multiple states**. Take the U.S.-led invasion of Iraq in 2003 for example. Although often seen as a case of U.S. unilateralism, this is not entirely accurate. The United States relied on earlier UN Security Council resolutions for legal justification, so at minimum the United States needed other members of the Security Council to have voted in favor of relevant resolutions. It also sought a so-called second resolution that would have explicitly authorized the use of force, and the U.S. failure to obtain Security Council passage of this authorization reduced international support for the U.S.-led operation (Thompson, 2009). In addition, the United States sought to enlist other partners in the “coalition of the willing” that conducted the military operation. The United States could have gone it alone if it chose to, but it clearly had a strong preference to obtain as much legitimacy as it could from the presence of coalition partners. In short, effective unilateral enforcement is likely to be **rare**; norm enforcement will typically be more effective as a multilateral enterprise. **Multilateral cooperation is not automatic** however. By the familiar logic of collective action, states will be tempted to **free ride** on the enforcement efforts of others. As long as others enforce the nonproliferation or disarmament norm in question, free riders still enjoy the benefits. But free riders do not have to pay the costs of enforcement, in trade forgone, in diplomatic frictions with the target or its friends, or in potential casualties should military force come into play. If all states give in to the temptation to free ride, however, then **effective enforcement will not happen.** In some cases, a lack of participation in collective action may arise less from states deliberately free riding than from a **lack of consensus** about whether or not a particular state is actually violating a particular norm. There can be ambiguity about the standards for ascertaining norm compliance or about the evidence of a violation. When this occurs, states can come to **different interpretations** of whether the situation even calls for an effort at enforcement (for examples involving NPT safeguards, see Goldschmidt, 2010) The end result will be similar to when free riding occurs, in that many **states will choose not to join in collective action**. The collective action problem is accentuated by **global power asymmetries**. The **U**nited **S**tates is so much more powerful than most other states, and has demonstrated such an obvious commitment to enforcing nonproliferation in certain cases, **that other states may hope that the** **U**nited **S**tates **will shoulder the entire burden** of enforcement. This creates an especially strong temptation to free ride. To the extent that the **U**nited **S**tates cannot on its own bring about **norm compliance**, however, the collective action problem will become a major barrier to enforcement of nonproliferation norms.

### 1NC---Climate D

#### It’s a tail-end scenario in the far future.

Dr. Amber Kerr et al. 19, Energy and Resources PhD at the University of California-Berkeley, known agroecologist, former coordinator of the USDA California Climate Hub; Dr. Daniel Swain, Climate Science PhD at UCLA, climate scientist, a research fellow at the National Center for Atmospheric Research; Dr. Andrew King, Earth Sciences PhD, Climate Extremes Research Fellow at the University of Melbourne; Dr. Peter Kalmus, Physics PhD at the University of Colombia, climate scientist at NASA’s Jet Propulsion Lab; Professor Richard Betts, Chair in Climate Impacts at the University of Exeter, a lead author on the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in Working Group 1; Dr. William Huiskamp, Paleoclimatology PhD at the Climate Change Research Center, climate scientist at the Potsdam Institute for Climate Impact Research; 6/4/2019, “Claim that human civilization could end in 30 years is speculative, not supported with evidence,” <https://climatefeedback.org/evaluation/iflscience-story-on-speculative-report-provides-little-scientific-context-james-felton/>, Stras

The content of the IFLScience article is mostly an accurate representation of the contents of the Breakthrough report, but the article tends to gloss over important caveats and probabilities that are given in the report. The least accurate part of the IFLScience article is the headline, which is an outright misrepresentation of the report. The article title states that there is, overall, a “high probability” of human civilization coming to an end in 30 years. This is extremely misleading. What the Breakthrough report actually says is that, in the most unlikely, “long-tail” biophysical scenario where climate feedbacks are much more severe than we expect, THEN there is a high likelihood of human civilization coming to an end. But the report authors explicitly state that this “high-end scenario” is beyond their capacity to model or to quantitatively estimate.

Daniel Swain, Researcher, UCLA, and Research Fellow, National Center for Atmospheric Research:

The article uncritically reproduces claims from a recent report released by an Australian thinktank regarding the purported “end of human civilization” due to climate change over the next 30 years. While there is plenty of scientific evidence that climate change will pose increasingly existential threats to the most vulnerable individuals in society and to key global ecosystems, even these dire outcomes aren’t equivalent to the “annihilation of intelligent life,” as is claimed in the report.

Andrew King, Research fellow, University of Melbourne:

The report this article is based on describes a scenario which is unlikely, but several aspects of what is included in the report are likely to worsen in coming decades, such as the occurrence of deadly heatwaves. The conclusion of a high likelihood that human civilisation will end is false, although there is a great deal of evidence that there will be many damaging consequences to continued global warming over the coming decades.

Peter Kalmus, Data Scientist, Jet Propulsion Laboratory:

I don’t think it’s so easy to discount the essential warning of this report. However, it would have been stronger if the authors were more careful not to mention the unsupported concept of near-term human extinction, and the unsupported probabilistic claim that there is a “high likelihood” of their 2050 scenario which includes the collapse of civilization. I do not understand why non-scientist writers (neither report author is a scientist) feel a need to exaggerate sound scientific findings, when those findings are already quite alarming enough. I feel that humanity should undertake urgent climate action just as the report authors do, but I feel that misrepresenting the science is unhelpful and unnecessary.

Richard Betts, Professor, Met Office Hadley Centre & University of Exeter:

This is a classic case of a media article over-stating the conclusions and significance of a non-peer reviewed report that itself had already overstated (and indeed misrepresented) peer-reviewed science---some of which was already somewhat controversial. It appears that there was not a thorough independent check of the credibility of the message.

Notes:

[1] See the rating guidelines used for article evaluations.

[2] Each evaluation is independent. Scientists’ comments are all published at the same time.

ANNOTATIONS

The statements quoted below are from the article; comments are from the reviewers (and are lightly edited for clarity).

New Report Warns “High Likelihood Of Human Civilization Coming To An End” Within 30 Years

Richard Betts, Professor, Met Office Hadley Centre & University of Exeter:

The headline overstates the conclusions of the report (which is already overdoing things). The reports says it presents a scenario, and under that scenario and all the assumptions within it, the report claims that there is a “high likelihood of human civilization coming to and end”---but even then, the report itself does not give the end of civilisation within 30 years. The process supposedly leading ultimately to collapse begins around 2050 but takes a long time to take effect. Also the processes themselves are not well-grounded in science, as they over-interpret published work.

#### Even extreme warming won’t cause extinction

Dr. Toby Ord 20, Senior Research Fellow in Philosophy at Oxford University, DPhil in Philosophy from the University of Oxford, The Precipice: Existential Risk and the Future of Humanity, Hachette Books, Kindle Edition, p. 110-112

But the purpose of this chapter is finding and assessing threats that pose a direct existential risk to humanity. Even at such extreme levels of warming, it is difficult to see exactly how climate change could do so. Major effects of climate change include reduced agricultural yields, sea level rises, water scarcity, increased tropical diseases, ocean acidification and the collapse of the Gulf Stream. While extremely important when assessing the overall risks of climate change, none of these threaten extinction or irrevocable collapse.

Crops are very sensitive to reductions in temperature (due to frosts), but less sensitive to increases. By all appearances we would still have food to support civilization.85 Even if sea levels rose hundreds of meters (over centuries), most of the Earth’s land area would remain. Similarly, while some areas might conceivably become uninhabitable due to water scarcity, other areas will have increased rainfall. More areas may become susceptible to tropical diseases, but we need only look to the tropics to see civilization flourish despite this. The main effect of a collapse of the system of Atlantic Ocean currents that includes the Gulf Stream is a 2°C cooling of Europe—something that poses no permanent threat to global civilization.

From an existential risk perspective, a more serious concern is that the high temperatures (and the rapidity of their change) might cause a large loss of biodiversity and subsequent ecosystem collapse. While the pathway is not entirely clear, a large enough collapse of ecosystems across the globe could perhaps threaten human extinction. The idea that climate change could cause widespread extinctions has some good theoretical support.86 Yet the evidence is mixed. For when we look at many of the past cases of extremely high global temperatures or extremely rapid warming we don’t see a corresponding loss of biodiversity.87

[FOOTNOTE]

We don’t see such biodiversity loss in the 12°C warmer climate of the early Eocene, nor the rapid global change of the PETM, nor in rapid regional changes of climate. Willis et al. (2010) state: “We argue that although the underlying mechanisms responsible for these past changes in climate were very different (i.e. natural processes rather than anthropogenic), the rates and magnitude of climate change are similar to those predicted for the future and therefore potentially relevant to understanding future biotic response. What emerges from these past records is evidence for rapid community turnover, migrations, development of novel ecosystems and thresholds from one stable ecosystem state to another, but there is very little evidence for broad-scale extinctions due to a warming world.” There are similar conclusions in Botkin et al. (2007), Dawson et al. (2011), Hof et al. (2011) and Willis & MacDonald (2011). The best evidence of warming causing extinction may be from the end-Permian mass extinction, which may have been associated with large-scale warming (see note 91 to this chapter).

[END FOOTNOTE]

So the most important known effect of climate change from the perspective of direct existential risk is probably the most obvious: heat stress. We need an environment cooler than our body temperature to be able to rid ourselves of waste heat and stay alive. More precisely, we need to be able to lose heat by sweating, which depends on the humidity as well as the temperature.

A landmark paper by Steven Sherwood and Matthew Huber showed that with sufficient warming there would be parts of the world whose temperature and humidity combine to exceed the level where humans could survive without air conditioning.88 With 12°C of warming, a very large land area—where more than half of all people currently live and where much of our food is grown—would exceed this level at some point during a typical year. Sherwood and Huber suggest that such areas would be uninhabitable. This may not quite be true (particularly if air conditioning is possible during the hottest months), but their habitability is at least in question.

However, substantial regions would also remain below this threshold. Even with an extreme 20°C of warming there would be many coastal areas (and some elevated regions) that would have no days above the temperature/humidity threshold.89 So there would remain large areas in which humanity and civilization could continue. A world with 20°C of warming would be an unparalleled human and environmental tragedy, forcing mass migration and perhaps starvation too. This is reason enough to do our utmost to prevent anything like that from ever happening. However, our present task is identifying existential risks to humanity and it is hard to see how any realistic level of heat stress could pose such a risk. So the runaway and moist greenhouse effects remain the only known mechanisms through which climate change could directly cause our extinction or irrevocable collapse.

This doesn’t rule out unknown mechanisms. We are considering large changes to the Earth that may even be unprecedented in size or speed. It wouldn’t be astonishing if that directly led to our permanent ruin. The best argument against such unknown mechanisms is probably that the PETM did not lead to a mass extinction, despite temperatures rapidly rising about 5°C, to reach a level 14°C above pre-industrial temperatures.90 But this is tempered by the imprecision of paleoclimate data, the sparsity of the fossil record, the smaller size of mammals at the time (making them more heat-tolerant), and a reluctance to rely on a single example. Most importantly, anthropogenic warming could be over a hundred times faster than warming during the PETM, and rapid warming has been suggested as a contributing factor in the end-Permian mass extinction, in which 96 percent of species went extinct.91 In the end, we can say little more than that direct existential risk from climate change appears very small, but cannot yet be ruled out.

## Space War ADV

### 1NC---Space War D

#### No space war

**Hall 15** [Luke Penn-Hall, Analyst at The Cipher Brief, M.A. from the Johns Hopkins School for Advanced International Studies, B.A. in International Relations and Religious Studies from Claremont McKenna College, “5 Reasons “Space War” Isn’t As Scary As It Sounds”, The Cipher Brief, Aug 18, 2015, <https://www.thecipherbrief.com/article/5-reasons-%E2%80%9Cspace-war%E2%80%9D-isn%E2%80%99t-scary-it-sounds>]

The U.S. depends heavily on military and commercial satellites. If a less satellite-dependent opponent launched an anti-satellite (ASAT) attack, it would have far greater impact on the U.S. than the attacker. However, it’s not as simple as that – for the following reasons: 1. An ASAT attack would likely be **part of a larger, terrestrial attack**. An attack on space assets would be no different than an attack on territory or other assets on earth. This means that no space war would stay limited to space. An ASAT campaign would be part of a larger conventional military conflict that would play out on earth. 2. Every country with ASAT capabilities also needs **sat**ellite**s**. While the United States is the most dependent on military satellites, most other countries need satellites to participate in the global economy. All countries that have the technical ability to play in this space – the U.S., Russia, China and India - also have a **vested interest** in preventing the militarization of space and protecting their own satellites. If any of those countries were to attack U.S. satellites, it would likely **hurt them** far more than it would hurt the United States. 3. Destruction of satellites could create a damaging chain reaction. Scientists warn that the violent destruction of satellites could result in an effect called an ablation cascade. High-velocity debris from a destroyed satellite could crash into other satellites and create more high-velocity debris. If an ablation cascade were to occur, it could render certain orbital levels completely unusable for centuries. 4. Any country that threatened access to space would threaten the global economy. Even if a full-blown ablation cascade didn’t occur, an ASAT campaign would cause debris, making operating in space more hazardous. The global economy relies on satellites and any disruption of operations would be met with worldwide disapproval and severe economic ramifications. 5. International **Prohibits** the Use of ASAT Weapons. Several international treaties expressly **prohibit signatory nations** from attacking other countries’ space assets. It is generally accepted that space should be treated as a global common area, rather than a military domain. While it remains necessary for military planners to create contingency plans for a, space war it is a **highly unlikely** scenario. All involved parties are **incentivized against** attacking. However, if a space war did occur, it would be **part of** a larger conflict **on Earth**. Those concerned about the potential for war in space should be more concerned about the potential for war, period.

#### No miscalc or escalation

**Pavur 19** [James, DPhil Researcher at the Cybersecurity Centre for Doctoral Training at Oxford University, and Ivan Martinovic, Professor of Computer Science in the Department of Computer Science at Oxford University, “The Cyber-ASAT: On the Impact of Cyber Weapons in Outer Space”, 2019 11th International Conference on Cyber Conflict: Silent Battle, <https://ccdcoe.org/uploads/2019/06/Art_12_The-Cyber-ASAT.pdf>]

1. Limited Accessibility Space is difficult. Over 60 years have passed since the first Sputnik launch and only nine countries (ten including the EU) have orbital launch capabilities. Moreover, a launch programme alone does not guarantee the **resources** and **precision required** to **operate a meaningful ASAT capability**. Given this, one possible reason why **space wars have not broken out** is simply because only the US has ever had the ability to fight one [21, p. 402], [22, pp. 419–420]. Although launch technology may become cheaper and easier, it is unclear to what extent these advances will be distributed among presently non-spacefaring nations. **Limited access to orbit** necessarily reduces the scenarios which could plausibly escalate to ASAT usage. Only major conflicts between the handful of states with ‘space club’ membership could be considered possible flashpoints. Even then, the **fragility of an attacker’s own space assets** creates **de-escalatory pressures** due to the **deterrent effect of retaliation**. Since the earliest days of the space race, dominant powers have recognized this dynamic and demonstrated an inclination **towards de-escalatory space strategies** [23]. B. Attributable Norms There also exists a **long-standing normative framework** favouring the **peaceful use of space**. The effectiveness of this regime, centred around the Outer Space Treaty (**OST**), is highly contentious and many have pointed out its serious legal and political shortcomings [24]–[26]. Nevertheless, this status quo framework has somehow supported over **six decades of relative peace** in orbit. Over these six decades, **norms have become deeply ingrained** into the way states describe and perceive space weaponization. This de facto codification was dramatically demonstrated in 2005 when the US found itself on the short end of a 160-1 UN vote after opposing a non-binding resolution on space weaponization. Although states have occasionally pushed the boundaries of these norms, this has typically occurred through incremental legal re-interpretation rather than outright opposition [27]. Even the most notable incidents, such as the 2007-2008 US and Chinese ASAT demonstrations, were couched in rhetoric from both the norm violators and defenders, depicting space as a peaceful global commons [27, p. 56]. Altogether, this suggests that **states perceive real costs** to breaking this normative tradition and may even **moderate their behaviours** accordingly. One further factor supporting this norms regime is the **high degree of attributability** surrounding ASAT weapons. For kinetic ASAT technology, **plausible deniability** and **stealth** are essentially **impossible**. The literally explosive act of launching a rocket cannot evade detection and, if used offensively, retaliation. This imposes **high diplomatic costs** on ASAT usage and testing, particularly during peacetime. C. Environmental Interdependence A third stabilizing force relates to the **orbital debris consequences** of ASATs. China’s 2007 ASAT demonstration was the largest debris-generating event in history, as the targeted satellite dissipated into thousands of dangerous debris particles [28, p. 4]. Since debris particles are indiscriminate and unpredictable, they often threaten the attacker’s own space assets [22, p. 420]. This is compounded by Kessler syndrome, a phenomenon whereby orbital debris ‘breeds’ as large pieces of debris collide and disintegrate. As space debris remains in orbit for hundreds of years, the **cascade effect** of an ASAT attack can constrain the attacker’s long-term use of space [29, pp. 295– 296]. Any state with kinetic ASAT capabilities will likely also operate satellites of its own, and they are necessarily exposed to this collateral damage threat. Space debris thus acts as a strong strategic deterrent to ASAT usage.

### 1NC---AT: Preempts

#### AT---Riederer

#### 1---No warrants---it’s a rhetorical bashing of Silicon Valley talking about mining

#### 2---The brightline is higher---they have to prove instances of benefits being exaggerated

#### ---pelton is the director of a research institute that specializes in space activities

#### ---wingo is leader of NASA's the Lunar Orbiter Image Recovery Project

#### 3---“Getting there takes to long” is wrong---our ev is 5 years newer and

#### Yes asteroids in our grasp -

PW 18 6-11-2018 "The Asteroid Trillionaires" <https://physicsworld.com/a/the-asteroid-trillionaires/> (Physics World)//Elmer

Within our reach But how many asteroids are potential mining hotspots? Martin Elvis, a Harvard University astrophysicist with an interest in asteroid mining, developed an equation in 2013 to estimate the number of asteroids that might be potential mining candidates with our current technology. The equation accounts for the number of asteroids within reach of today’s rocket ships, the likelihood of them being worth mining, whether it is practically feasible to mine them, and whether they would yield a profit. When he first ran the numbers back in 2013, Elvis estimated that around 10 potentially metal-rich asteroids, and 18 sufficiently water-rich, lie within our grasp. SpaceX’s development of increasingly powerful rockets has bolstered the hopes of asteroid miners because it means we can travel further into space. But Elvis told me that recent press reports claiming he thought the successful Falcon Heavy launch on 6 February had burst open the sky to potential asteroids were wide of the mark. “I made the remark at a conference in Texas recently and the press missed off the word ‘might’, but the truth is that I haven’t run the numbers yet. We need more data before I can run the numbers again, but a wild guess might be that this new fleet of heavy rockets could increase the numbers by a factor of 10.” Elvis was not just referring to Falcon Heavy either. Blue Origin’s New Glen rocket and, in the longer term, the New Armstrong rocket can all be added to the mix when Elvis next runs his equation. Yet even though the SpaceX rockets are boosting the hopes of asteroid miners who could one day provide his explorers with fuel and raw materials, Musk does not seem convinced. In fact, in 2003 he called asteroid mining “bogus” and, at least publicly, has not updated that view. Amara Graps, an astrophysicist who organizes the bi-annual Asteroid Science Intersections with In-Space Mine Engineering Conference (ASIME) and founded the Latvian initiative Baltics in Space, is more optimistic. “Elon will come around. He’s a clever guy and he’s surrounded by clever people. He’ll get there but I don’t know how to reach him to sell it to him.” Half the delegates at the most recent ASIME conference, which took place in Luxembourg in April, came from asteroid-mining companies, with the rest being asteroid scientists. Indeed, Graps believes the interface between scientists and business people is essential. The asteroid scientists’ role is to provide scientific support to the companies; addressing some of the companies’ largest asteroid science questions.

#### Plus, the scenario is close proximity asteroids

#### AT---Gardeneyes

#### 1---“economic Bubble” only applies if they fail – they will def make profits – we’ve read U/Q about it working and you haven’t read any evidence saying they fail outright which means no I/L to this offense.

#### 2---An analysis of dotcom cannot come to the level of analysis as pelton or wingo that are specific to capabilities now.

#### AT---No Neg Fiat

#### 1---Yes, its reciprocal lol

#### 2---Core neg ground---no cps = regressive debates

#### Locus of neg competition