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**US wins space race now due to private competition – its key to space dominance and militarization is good – the plan kills the US’s silver bullet against Chinese aggression**

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As Jeff Bezos, the wealthiest man on the planet, readies to launch himself into space aboard one of his own rockets, the world is watching the birth of a new dawn in space. Previously, America relied on its government agency, NASA, to propel it to the cosmos during the last space race with the Soviet Union. Today, America’s greatest hopes are with its private sector.

Jeff Bezos is not engaging in such risky behavior simply because he’s an adrenaline junky. No, he’s launching himself into orbit because his Blue Origins is in a titanic struggle with Elon Musk’s SpaceX — and Bezos’s firm is losing.

Whatever happens, **the American people will benefit from the competition that is shaping up between America’s space entrepreneurs. This has always been how innovation occurs: through** the dynamic, often **cutthroat competition between actors in the private sector.** While money is their ultimate prize, fame and fortune are also alluring temptations to make men like Musk and Bezos risk much of their wealth to change the world.

**The private space race** among these entrepreneurs **is part of a far more important marathon between** Red **China and the U**nited **S**tates**. Whichever nation wins the new space race will determine the future of the earth below.**

Consider this: Since winning its initial contracts to launch sensitive U.S. military satellites into orbit, **SpaceX has lowered the cost of military satellite launches** on taxpayers by “over a million dollars less” than what bigger defense contractors can do. Elon **Musk** is convinced that he **can bring these costs down even more**, thanks to his reusable Falcon 9 rocket.

The competition between the private space start-ups is fierce — just as the competition between Edison and Westinghouse was — but the upshot is ultimately greater innovation and lower costs for you and me. In fact, Elon Musk insists that if NASA gives SpaceX the contract for building the Human Landing System for the Artemis mission, NASA would return astronauts to the lunar surface by 2024 — four years before NASA believes it will do so. (Incidentally, 2024 is also when China anticipates having a functional base on the moon’s southern pole.)

Whereas China has an all-of-society approach to its space race with the United States, Washington has yet to fully galvanize the country in the way that John F. Kennedy rallied America to wage — and win — the space race in the Cold War. **America’s private sector**, therefore, **is the silver bullet against China’s quest for** total **space dominance. If left unrestricted by** meddlesome **Washington** bureaucrats, **these companies will ensure** that **the U**nited **S**tates **retains its overall competitive advantage over China** — and all other challengers, for that matter.

Indeed, the next four years could prove decisive in who will be victorious.

Enter the newly minted NASA director, Bill Nelson, whose station at the agency has effectively poured cold water on the private sector’s ambitious space plans. “Space is not going to be the Wild West for billionaires or anyone else looking to blast off,” Nelson admonished an inquiring reporter.

Why not?

America’s actions during its western expansion created a dynamic and advanced nation that was well-positioned to dominate the world for the next century. Should we not attempt to emulate this in order to remain dominant in the next century?

More important, this is precisely how **China treats space: as a new Wild West** . . . but one in **which Beijing’s forces will dominate**. China takes a leap-without-looking approach to space development — everything that can be done to further its grand ambition of becoming the world’s most dominant power by 2049 will be done. Meanwhile, the Biden administration wants to prevent America’s greatest strength, the free market, from helping to beat its foremost geopolitical competitor.

Nelson’s comments are fundamentally at odds with America’s spirit and animating principles. Whatever one’s opinion about Bezos or Musk, the fact is that their private space companies are inspiring greater innovation today in the space sector after years of its being left in the sclerotic hands of the U.S. government.

Sensing that the federal government’s dominance of U.S. space policy is waning, the Biden administration would rather cede the strategic high ground of space to China than let wildcatting innovators do the hard work. Today, the Federal Aviation Authority (FAA) and NASA are contriving new ways for strangling the budding private space sector, just as it is taking flight.

Risk aversion is not how one innovates. Risk is what led Americans to the moon just 66 years after the Wright brothers flew their first airplane. A willingness for risk doesn’t exist today in the federal government — which is why the feds shouldn’t be running space policy.

The U.S. government should be partnering with the new space start-ups, not shunning them. The FAA should be automatically approving SpaceX launches, not stymying them. The federal government will not win space any more than it could win the West or build the locomotive. It takes strong-willed, brilliant individuals of a rare caliber to do that. All government can do is to give the resources and support to private-sector innovators and let them make history for us.

The next decade will decide who wins space. Let it be America — and let America’s dynamic start-ups win that race, not China’s state capitalism.

**Space competition will determine hegemonic power on Earth**

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**The strategic competition between the U.S. and China is fierce** even **in** **space** outside of the earth. What do the two countries compete for in space? What are their objectives and what strategic calculations did they start from? Will the space race between the two countries lead to competition over space hegemony? This is one of the most interesting issues for U.S.-China observers in recent days. The space race between the U.S. and China is not just a number fight. How many satellites and spaceships have been launched and how many space stations have been established are the questions that mattered in the past. These mattered for the convenience and benefit for mankind. It could also make possible for some of the curiosity about the universe to be solved. However, starting the 21st century, the space race between the U.S. and China has progressed into an intense, high-level strategic battle. **Whoever rules space rules the future** There is one reason why **the** two **countries' space strategy competition will inevitably lead to a hegemony competition**. This is **because they try to conquer the space order**. Conquering the space order is to define and establish the space order. **Those who dominate space will dominate almost all sectors of the future world, including economy, technology, environment, cyberspace, transportation and energy**. That's why the United States is considered as a hegemonic country on Earth today. **The U.S. is recognized as a hegemonic country because it establishes and leads the economic, financial, trade, political, and diplomatic order.** There are two areas in the world today where international order has not been established. One is virtual space, which is the cyber world. The other is the space. Since the international order of these two areas is closely correlated with each other, it is likely that the establishment of the order in these two areas will be pursued simultaneously. This means that cyber order cannot be discussed without discussing satellite issues. The Communist Party of China recognized this early on. At the 19th National Communist Party Congress in 2017, it expressed its justification for establishing space order. President Xi Jinping declared that China's diplomatic stage in the 21st century has expanded beyond the Earth into space and virtual space. It was the moment when China defined the concept of diplomatic space as the "universe" beyond the Earth. He then explained that the establishment of a system that can even manage the order of the universe and the virtual world eventually means the establishment of practical governance. Therefore, he justified that China's diplomatic horizon has no choice but to expand into space. Furthermore, he stressed that he is confident that the ideation of building such governance serves as the foundation for the community of common destiny for mankind which China pursues. In other words, he publicly urged China to have the capabilities and means to become a key country in building governance in these two areas. This led the Trump administration to spare no effort to develop space science and technology and space projects, which are the basis of space order. Since President George W. Bush, the maintenance work for supremacy in space has been carried out. President Obama also introduced a policy to encourage U.S. private companies to participate in space projects to expand the foundation for supremacy in space. It was President Trump who actualized all these. He was the one who legalized private companies' space development projects under the Space Policy Directive-I. He also thoroughly reflected his “America First” principle in the space business. For example, all the substances obtained in space, including minerals, were no longer defined as "common goods." He also promised that space activities by private companies in the United States would be free from restrictions such as the Outer Space Treaty and the 1979 resolution by the United Nations Committee on the Peaceful Uses of Outer Space. **Space and the moon were known as repositories of resources. As it became known that the resources that are scarce or will be depleted on Earth are very abundant outside the Earth in space, the space race has gotten intense. This is why the space race has been promoted on a geoeconomic level**. However, in order to secure these benefits of geoeconomic strategies, geopolitical strategies must be accompanied. In other words, military defenses should be backed up to protect the resource acquisition process. Fearing this, the United Nations Committee on the Peaceful Uses of Outer Space strictly regulates the military use of space. However, the fact that the logic of developing naval power to protect long-range foreign interests on Earth is reflected in the strategic thinking of securing space profits is the decisive factor that has driven the space race today. The repositories of resources and future energy sources There are three strategic benefits that drive the U.S.-China competition for supremacy in space. The first is the infinite resource in space. **There are endless resources buried in more than 10,000 asteroids orbiting the Earth.** **They are known to have an abundance of resources such as carbon, zinc, cobalt, platinum, gold, silver and titanium, in which platinum and titanium, for example, can be sold for $30,000 to $50,000 per kilogram.** Second, the **future energy source lies in space**. **Power supply using solar energy will be possible by establishing a space power plant that concentrates solar energy in the Earth-Moon area and transmitting it to Earth through laser beams. Here, the supplied solar power is known to be 35 to 70% more powerful than the solar energy on Earth. By 2100, 70 terawatts of energy will be needed, and it is expected that 332 terawatts can be supplied through the development of space solar power plants in a geostationary orbit. Third, the desire to dominate space for hegemony has established the space competition relationship between the U.S. and China. Although each started from different strategic interests, in the end, they have one common goal.** First of all, **China** wants to be free from the U.S. GPS system. This is because only through the freedom China can prevent its future weapons system from becoming vulnerable to U.S. control and restrictions. It **is planning to achieve its goal of establishing a so-called "Space Silk Road" by expanding China's "BeiDou" navigation system to the regions within One Belt One Road and the national satellite and communication systems. The U.S. also plans to spend $25 billion to develop GPS3 systems with stronger defense capabilities against Chinese space and cyberattacks, by 2025.** **The competition between the U.S. and China to establish a space station in order to secure the benefits from space strategies is inevitable.** This is because a space station is the foundation for establishing space order. As the space station has the purpose of protecting and defending from enemies**, militarization is inevitable in the process. It is clear that the outcome will lead to a space arms race. This is why the competition over supremacy in space between the U.S. and China has the aspects of the New Cold War outside the Earth.** Space is a blue ocean. It is a world without order. Preemption is therefore important. In order to prepare space order and accompanying laws, norms, and systems, the U.S. and China have been engaged in a fierce battle through space projects. This is because **space is the decisive factor in the operation of energy, resources, environment, communication, and advanced military weapons systems in the future. Space is no longer a dream world.** Of course, it takes a lot of time for these strategic benefits to become a reality. However, the Fourth Industrial Revolution and the development of AI (Artificial Intelligence) technology will speed up the pace. This is because economic problems can be solved if spacecraft recycling is made possible with the participation of private companies and facilities related to space stations and mineral mining equipment are set up with 3D printers.

**Heg is sustainable but not impervious to collapse**

Hal **Brands**, 5-1-20**21**, Henry A. Kissinger Distinguished Professor At The Johns Hopkins School Of Advanced International Studies, China’s Creative Challenge—and the Threat to America, Commentary Magazine, https://www.commentarymagazine.com/articles/hal-brands/chinas-geopolitical-challenge-threat-to-america//Khan

FINALLY, CHINA is testing the patterns of history simply by taking on the United States. America is the most lethal competitor of the modern era, and it now has its sights set squarely on Beijing. Consider the historical record. In an environment populated mostly by hostile autocracies, America became a continental behemoth and the world’s strongest economy within a century. It then achieved something no other modern great power has managed—lasting, if periodically contested, hegemony in its home region. During the 20th century, America or the coalitions it supported decisively defeated a series of illiberal powers—Germany (twice), Japan, the Soviet Union—that challenged its vital interests. Along the way, Washington peacefully wrested global leadership from the United Kingdom. For over a century, the surest path to destruction has been inviting the focused hostility of the United States. America’s formidable record is the product of many factors. Vast resource endowments and uniquely advantageous geography have allowed America to project power globally without facing severe geopolitical threats near home. Similarly, the fact that America is powerful and far away leads countries all around the Eurasian periphery to ally with the United States against nearby predators that threaten their independence. The country’s relatively open economy has created great dynamism and innovation; its democratic institutions have allowed it, more often than not, to use its other advantages effectively. And the slowness with which America sometimes mobilizes to confront threats contributes to the single-mindedness with which it eventually combats them. The type of superpower America is also matters. Because America is a liberal nation, it has taken a liberal approach to global power. Since 1945, it has delivered freedom of the seas, a global reserve currency, and a massive market for foreign goods, in addition to providing security and stability in key regions. Those attributes have made other countries support the American cause, which makes American hegemony even harder to overturn. Neither China nor any other country can compete on these dimensions: Beijing lacks the ability to act as a global security provider and the willingness (as a neo-mercantilist actor) to anchor a truly open global economy. It cannot fully open its market without exposing key industries to competition and wrecking plans to reduce strategic dependence on the West. Even if China’s raw power exceeded America’s, its ability to act as a comparatively benign and popular hegemon would not. Having helped the United States defeat the Soviet Union, Chinese leaders understood the peril of provoking American hostility: This was the crux of Deng Xiaoping’s famous dictum about “hiding” capabilities and “biding” time. Chinese statecraft in the post-Tiananmen era was meant to increase Beijing’s power while delaying an American response. The building of deep commercial and financial ties with the United States not only fueled Chinese growth; it also made it more painful for America to turn toward competition. The cultivation of American elites in academia, business, and politics strengthened supporters of continued engagement. Even as Chinese statecraft become more assertive after 2008, Beijing moved incrementally—in the South China Sea and elsewhere—to avoid giving America an eye-opening “Sputnik moment.” And even as the relationship deteriorated during the Obama years, the Chinese leadership used the lure of cooperation on climate change and talk of a “new type of great-power relations” to discourage a sharper pivot in American policy. Historians will one day marvel at how well this strategy—combined with America’s post-9/11 distraction—worked. It took two decades, from the time serious observers began warning about the Chinese challenge, for the United States to adjust its statecraft decisively. During that time, China gained access to technology, capital, and markets that powered its ascent; there emerged an incredibly complex interdependence that continues to retard multilateral mobilization against Beijing. If the United States loses the competition with China, it will be—in no small part—because Beijing successfully anesthetized Washington to a growing peril. The bad news, from Xi’s vantage point, is that the game is up. Predatory economic behavior that America once tolerated has become more threatening as Beijing worked its way up global value chains. Small nibbles at the status quo eventually added up to larger, more alarming shifts. The Chinese government prematurely let the mask slip after the 2008–09 financial crisis, with more assertive diplomacy that gradually made the thesis of America’s engagement policy—that Beijing would mellow over time—impossible to defend. And by the Trump era, China had simply gotten tired of waiting and disguising its ambitions. COVID then did more than any Committee on the Present Danger could ever have done to reveal both the utterly cynical nature of the CCP regime—which sought to stymie the virus’s spread within China even as it allowed continued travel from Wuhan to the world—and the fact that this behavior could mortally imperil Americans’ well-being. China is no longer the “stealth superpower”—there is now a bipartisan consensus that America must thwart its global designs. From here onward, Beijing must forcefully wrest influence from a dangerous hegemon that is alert to a new authoritarian challenge. STRUCTURAL CONSTRAINTS don’t determine everything: History wouldn’t be very interesting if they did. The United States always had profound advantages over the Soviet Union, but it wouldn’t have won the Cold War had it not worked feverishly to shore up Western Europe in the late 1940s and maintain a military balance that made Soviet aggression seem suicidal. Strategic urgency and commitment were what ultimately allowed America to make the most of its strengths. That’s worth keeping in mind today. The fact that Chinese power and influence have grown so markedly in recent decades and that the resulting challenge has become so stark show the impact that determined, innovative strategy can have. The dilemmas that the United States confronts, in areas from 5G technology to the military balance in the Taiwan Strait, illustrate the costs of strategic lethargy. Indeed, America is fully capable of squandering its advantages if it degrades or destroys its own democracy, declines to make domestic reforms and investments to maintain its competitive edge, fails to rally the overlapping coalitions needed to resist Chinese ambitions, or delays in driving the military innovation required to shore up a sagging balance in the Western Pacific. The list of hard policy problems America must urgently solve to prevail against China is itself long and formidable. And even if Washington does prevail in that rivalry, America may absorb significant setbacks—and the international order may absorb significant damage—in the process. Yet as rough as the road ahead looks from Washington, it ought to look even rougher from Beijing. The Chinese Communist Party runs a profoundly illiberal regime that is trying to overcome centuries of liberal dominance. China is straining against a strategic geography and international system that surely seem more constraining than inviting. Chinese strategists must find a way of breaking America’s position in the Western Pacific while avoiding the potential cataclysm of major war. And Beijing is taking on a superpower that has thrashed all previous comers. Smart strategies have permitted Beijing to do remarkably well, so far, in managing these problems. But many of those strategies face an uncertain future, in part because the international complacency that allowed them to flourish has been replaced—gradually, but increasingly—with international concern. This isn’t to say that China’s ambitions are hopeless illusions. In the coming years, there will be an intense interaction between an America that is adapting its strategies to deal with a pressing threat and a China that will have to adjust its own approaches in light of that response. Even American success in this interaction could bring new dangers: If Chinese leaders perceive that their window to achieve grand geopolitical goals is closing, then the regime could become even more aggressive in seeking to revise the global order while it still can. Much thus hinges on the quality of decisions made in Washington and other capitals around the world. But the fact that so many characteristics of modern great-power politics seem to favor the United States probably gives the reigning superpower better options and more room for error than its autocratic challenger. Nothing is predetermined: Beijing may still succeed in displacing the United States as the primary power in Asia and, eventually, the world. Yet if it does, that outcome will represent a catastrophic failure of American statecraft—or an awesome triumph of Chinese strategy in overcoming the great obstacles that litter Beijing’s path to hegemony.

**Decline causes unstable nuclear alliances that cause war**

**Hayes 18** [Peter Hayes, Nautilus Institute, Berkeley, California, USA; Center for International Security Studies, Sydney University. Trump and the Interregnum of American Nuclear Hegemony. November 8, 2018. <https://www.tandfonline.com/doi/full/10.1080/25751654.2018.1532525>]

During a post-hegemonic era, long-standing nuclear alliances are likely to be replaced by ad hoc nuclear coalitions, aligning and realigning around different congeries of threat and even actual nuclear wars, with much higher levels of uncertainty and unpredictability than was the case in the nuclear hegemonic system. There are a number of ways that this dynamic could play out during the interregnum, and these dynamics are likely to be inconsistent and contradictory. In some instances, the sheer momentum of past policy combined with bureaucratic inertia and the potency of political, military service and corporate interests, may ensure that residual aspects of the formerly hegemonic postures are adhered to even as formal nuclear alliances rupture. Even as they reach for the old anchors, these states may be forced to adjust and retrench strategically, or start to take their own nuclear risks by making increasingly explicit nuclear threats and deployments against nuclear-armed adversaries – as Japan has begun to do with reference to its “technological deterrent” since about 2012.9 This period could last for many years until and when nuclear war breaks out and leads to a post-nuclear war disorder; or a new, post-hegemonic strategic framework is established to manage and/or abolish nuclear threat. Under full-blown American nuclear hegemony, fewer states had nuclear weapons, the major nuclear weapons states entered into legally binding restraints on force levels and they learned from nuclear near-misses to promulgate rules of the road and tacit understandings. The lines drawn during full-blown collisions involving nuclear weapons were stark and concentrated the minds of leaders greatly. In a nuclear duel, it was clear that only one of two sides could fire first; the only question was which one. Now, with nine nuclear weapons states, and conflicts conceivably involving three, four or more of them, no matter how much leaders concentrate, it will not be evident who is aiming at who, who may fire first, and during a volley, who fired first and even who hit whom. In a highly proliferated world, nuclear-armed states may feel driven to obtain larger nuclear forces able to deter multiple adversaries at the same time, sufficient to conduct not only a few nuclear attacks but configured to fight more than one protracted nuclear war at a time, especially in nuclear states torn apart by civil war and post-nuclear attack reconstruction. The first time nuclear weapons are used since 1945 will be shocking, the second time, less so, the third time, the new normal.

**CP**

**1NC – Clean Fuel**

**The use of propellants other than liquid hydrogen and liquid oxygen to fuel rocket launches is unjust.**

**Liquid hydrogen/oxygen are safe**

**Mortillaro 21** [Nicole Mortillaro, CBC News Senior Reporter, editor of the Journal of the Royal Astronomical Society of Canada, author of several books. "Rocket launches could be affecting our ozone layer, say experts." CBC, 4-22-2021, accessed 1-22-2022, https://www.cbc.ca/news/science/rocket-launches-environment-1.5995252] HWIC

There are different types of rocket propellants. Some, like liquid oxygen and liquid hydrogen, produce mainly water vapour and have little environmental impact. These were used in past shuttle launches and even in the Apollo-era Saturn V vehicles.

Then there are those that produce alumina particles in the stratosphere, such as those in solid rocket boosters, which were also used in past shuttle launches, and are still being used today by some launch companies.

Finally, there are those that deposit black soot in the stratosphere, such as kerosene used in SpaceX's Falcon 9 and Russia's Soyuz rockets.

It's the alumina and black soot that is most concerning to experts.

**Solves health**

**Case**

**Solvency**

**Top level no internal link to either scenario – none of their ev says private entities are key – there is no card in the aff that says countries are trying to mine / create debris / launching enough rockets to significantly impact warming**

**Even though the OST doesn’t bind private entities, governments still already restrict and regulate them to ensure just compliance in the squo**

**van Eijk 20** [Cristian van Eijk is finishing an accelerated BA in Law at the University of Cambridge. He holds a BA cum laude in International Justice and an LLM in Public International Law from Leiden University, and has previously worked at the T.M.C. Asser Institute and the International Commission on Missing Persons. “Sorry, Elon: Mars is not a legal vacuum – and it’s not yours, either.” Voelkerrechtsblog. May 11, 2020. <https://voelkerrechtsblog.org/sorry-elon-mars-is-not-a-legal-vacuum-and-its-not-yours-either/>] HW AL

Two provisions of the Outer Space Treaty (OST), both also customary, are particularly relevant here. OST article II: “Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” OST article III: “States… shall carry on activities in the exploration and use of outer space, including (…) celestial bodies, in accordance with international law”. SpaceX is a private entity, and is not bound by the Outer Space Treaty – but that does not mean it can opt out. Its actions in space could have consequences for the United States in three ways. First, the US, as SpaceX’s launch state, bears fault-based liability for injury or damage SpaceX’s space objects cause to other states’ persons or property (OST article VII, Liability Convention articles I, III). Second, the US, as SpaceX’s state of registry, is the sole state that retains jurisdiction and control over SpaceX objects (OST article VIII, Registration Convention article II). Both refer to objects in space and are irrelevant. According to article VI OST, States “bear international responsibility for national activities in outer space”, including Mars, including those by “non-governmental entities”. The US, as SpaceX’s state of incorporation, must authorise and continuously supervise SpaceX’s actions in space to ensure compliance with the OST (OST article VI) and international law (OST article III). In practice, this task is done by the US Federal Communications Commission, which licenses and regulates SpaceX. Article VI OST sets a specific rule of attribution, supplementing the customary rules of state responsibility (Stubbe 2017, pp. 85-104). SpaceX acts with US authorisation, and its conduct in space within and beyond that authorisation is attributable to the US (ARSIWA articles 5, 7). In the absence of circumstances precluding wrongfulness, the result is straightforward. If SpaceX breaches a US obligation under international law, the US bears responsibility for an internationally wrongful act.

**Double bind – the OST already implicates private entities which means either governments will violate space law which makes their impact inevitable or there's no impact to breaking it**

**Limitations on commons access such as private entity restrictions lead to backlash**

**Stang 13**

Gerald Stang (associate fellow at the EUISS) , 2013, "Global Commons: between cooperation and competition" European Institute for security studies, https://www.iss.europa.eu/sites/default/files/EUISSFiles/Brief\_17.pdf, // HW AW

Rapid economic development and increasing international trade are leading to a more crowded international stage and raising new challenges in the ‘global commons’ – those domains that are not under the control or jurisdiction of any state but are **open for use by countries, companies and individuals from around the world**. Their management involves increasingly complex processes to accommodate and integrate the interests and responsibilities of states, international organisations and a host of non-state actors. Shared rules regarding the usage of - and access to - the global commons encourage their peaceful and cooperative use. Over the last seven decades, the US has led in the creation of a liberal international order which has attempted to define these rules in such a way as to make it easier and more beneficial to join the order and follow the rules than it does to operate outside of (or undermine) it. With the rise of nonWestern, less liberal powers - particularly **China - questions must be asked regarding the durability of the existing processes for managing the global commons,** along with the potential for developing effective new processes that can address new threats and challenges. The EU is uniquely positioned to play an important role in giving value to existing multilateral frameworks and in developing new ones for international cooperation in these domains. But with a multitude of competing interests among stakeholders, much work remains to be done. What exactly are the global commons? Security analysts generally identify **four domains as global commons: high seas, airspace, outer space** and, now, cyberspace. From a security perspective, the primary concern is safeguarding ‘access’ to these domains for commercial and military reasons. It is important to highlight that this language differs from the discourse on commons developed by environmental analysts: their arguments focus on damage to the ‘condition’ of the commons from overuse by actors who do not have to pay direct costs. They worry about the depletion of shared resources such as ocean fish stocks, or the damage to shared domains such as Antarctica or the atmosphere. A third strand of analysis looks not at the need for ‘access’ to or preservation of the ‘condition’ of the commons, but at the capacity of the commons to provide ‘global public goods’. As there is no accepted definition of a global public good (a functioning trading system, peace, clean water, electricity, the internet, and many other things are often included), it may be wiser to focus on the four global commons relevant to security analysts mentioned above. While there are major differences between the ‘access’ views of security analysts and the ‘condition’ views of environmentalists, both are concerned about how the Global commons: Between cooperation and competition by Gerald Stang Photo by NASA / Rex Features (1568628a) European Union Institute for Security Studies April 2013 2 rules for use of the commons are set and enforced. In today’s interconnected world, **any limitations on access to the commons would be highly disruptive**. Militaries rely on access to the commons to pursue security goals in domains outside their sovereign control. Economic actors rely on the commons to trade and conduct business. **Changes to the condition of the commons can therefore disrupt commerce and security, not to mention the status of the global environment.** Each of the four commons discussed below possesses unique attributes and poses unique challenges for international cooperation and governance. Sea As the primary avenue for international commerce since ancient times, norms for access to and passage on the seas have developed and evolved over many years. Only in recent decades, however, have there been agreed regulatory frameworks and institutions to manage them. The UN Convention on the Law of the Sea (UNCLOS), first initiated in 1956 though not legally in force until 1994, is the primary international treaty regarding the sea, laying out rules for territorial boundaries (22km from shore), resource management and the rights of states within their exclusive economic zones (370km from shore). The International Tribunal for the Law of the Sea (ITLOS), created by UNCLOS, has the power to resolve disputes by States Parties. Except for the US, most countries and all global powers - including the EU-27 - have signed and ratified UNCLOS. The UN International Migratory Organization (IMO), created in 1948, regulates international shipping and rulings on safety, environmental and technical cooperation issues (the EU has observer status). As the world’s only global sea power, the United States has historically seen itself as the protector of free movement on the seas. With 11 carrier groups (Russia has one, rarely used) and hundreds of naval bases and allied ports throughout the globe, the US has a naval footprint that dwarfs all its allies and competitors. While countries such as Iran and China may be uncomfortable with US capacity to deny others access to the sea, US support for the creation and respect of transparent international regulations for use of the sea (which they adhere to themselves despite not having ratified UNCLOS), has allowed for the stable management of access to the seas. Except for the disruptive (but still rare) threat of piracy, access to the seas is generally a smooth and well-regulated process. The massive and relatively effective, if ad hoc, global response to the localised piracy problem off the coast of Somalia (for which the EU launched Atalanta, its own anti-piracy mission under the CSDP) highlighted the world’s impressive capacity to handle disruptions of this type. Territorial disputes exist in places like the South China Sea, but relate to historical boundary disagreements rather than conflict over rules of sea access. Normally, no state has an interest in disrupting sea trade. Even in times of crisis, while individual states may wish to deny their opponents access to certain regions, they are unlikely to harm their own interests by disrupting traffic on the world’s oceans. Environmental ‘condition’ issues in the sea commons are disconnected from ‘access’ issues. No single international treaty or body addresses pollution, overfishing or the various challenges in the melting Arctic. A confusing patchwork of sea basin cooperation groupings, regional fisheries management organisations and pollution monitoring agreements is in place. The integrated marine policy of the EU recognizes the need to improve governance of the seas while avoiding treaty congestion. While no unifying treaty or body to manage maritime issues is likely to appear, years of patient discussion in a variety of venues (of the type that the EU excels at) may lead to greater coherence and cooperation in managing environmental threats. Air International air travel requires the use of national airspace for continuous transit and involves detailed agreements that define transit rights. The UN International Civil Aviation Organisation, established in 1947, is the leading institution for regulating air travel. All EU countries are members, while the EU has observer status. As with piracy at sea, any potential disruption of access to the air commons is likely to come from non-state actors. While terrorist events can disrupt air traffic, however, intergovernmental cooperation between national police and security agencies is well established. Any systemic threat to the air commons appears so unlikely that some security analysts do not even include air as a one of the commons. Also like the sea commons, issues of management of environmental ‘condition’ are disconnected from ‘access’ issues. The accumulation of greenhouse gases is a form of pollution of the atmosphere, but the alarm stems from their effects on the biosphere rather than from the risk that the atmosphere may become unbreathable or inaccessible. The EU is a global leader on climate change, with the world’s most comprehensive emissions trading scheme and intense efforts to regulate and limit emissions. The Union has set the tone at the international level but has been unable to win agreement for an internal carbon tax or stronger emissions targets from external partners. European Union Institute for Security Studies April 2013 3 Space More than a thousand orbiting satellites facilitate communications in both the military and the civilian spheres, regulated by a mix of UN guidelines, bilater- al Cold War agreements and industry standards. The UN International Telecommunications Union (ITU) allocates radio spectrum and satellite orbits and develops international technical standards. Established in 1869, the ITU has almost universal membership among existing states, including all EU countries - though not the EU itself. The 1967 Outer Space Treaty, signed by all spacefaring nations, provides the minimal framework for activities in space, banning weapons of mass destruction and preventing states from claims to celestial bodies. The Treaty does not establish infrastructure for coordination, and consultation among party states is ad hoc. Following China’s destruction of one of its own satellites in 2007, there has been increasing concern about protection of satellites from attack. During the later stages of the Cold War, the US and the USSR tacitly agreed to a moratorium on testing anti-satellite weapons (ASAT) - but there are no binding rules in place. The satellite’s destruction also created a debris cloud which could have damaged other satellites or spacecraft. Unlike the sea and air domains, the problem of debris management in space indicates an overlap between ‘access’ and ‘condition’ issues. While access to space has previously been limited to a small number of states, **the increasing role of new actors (including from the private sector) suggests that the creation of comprehensive and binding regulations for the space commons may become more difficult.** The EU has pushed to become a key actor in space matters, working with the European Space Agency (ESA) - an intergovernmental body - on Galileo, Europe’s civilian satellite navigation system. In an effort to get ahead of the curve and manage uncertainty, the European Council approved a voluntary Code of Conduct for Outer Space Activities in late 2008 (revised in 2010) to address both space operations and space debris. It has only limited operational requirements but develops important cooperation, consultation, and notification mechanisms. To make it more palatable to the US and other states, it is not binding and has no enforcement mechanism. As with many efforts in multilateral regulation of the global commons, the US has been hesitant to agree to the Code for fear of diminishing its own freedom of manoeuvre. It may be an important step, however, in setting the groundwork for future space cooperation if the EU can follow up on the Code’s development with diplomatic action by bringing other space-faring countries on board. Cyberspace Cyberspace differs from the other commons because it is not a physical domain and because of the preponderant role of the private sector in both the infrastructure and the management of the domain. All of the physical nodes of the internet also exist within states and are subject to national law, rather than existing physically outside of national control as for the other commons. The American and security-related roots of the internet are reflected in how technical internet standards are managed. The Internet Corporation for Assigned Names and Numbers (ICANN), a private non-profit entity under contract with the US government, has ensured the coordination of internet addresses and registries since 1998. While ICANN operations have been stable - and their inclusive governance style has won imitators for handling technical issues - many countries prefer a formal international body to manage technical internet issues. The ITU has been suggested as a neutral management body, but this idea has been resisted by most Western states. Interestingly, non-Western states are pushing for international management of the internet within a framework that provides individual countries with rights and roles, rather than leaving it to the nonprofit sector to decide how the internet works. All EU-27 countries are members of the ITU and, following a European Parliament deliberation, voted as a bloc against the measures granting more power to the ITU, concerned over states wishing to regulate, control, and limit internet use. The UN Internet Governance Forum (IGF) has become the leading multi-stakeholder platform for states and other actors to debate internet governance. Regardless of the ICANN/ITU issue, states can filter and censor within their territories, and for the time being, efforts to protect against cyber attacks remain within the national sphere. Cyberspace allows for the spread of information, creating pressures for transparency in both democratic and non-democratic states. Discussions on the management of cyberspace, therefore, have become connected with those on the power of states to control information. Finally, although there is no environmental constitu- ency for cyberspace, there are constituencies of users and providers - private and public - who play a similar role in pushing for the protection of certain conditions in cyberspace. Unlike for sea and air domains, therefore, there is overlap between ‘access’ and ‘condition’ discussants. With worries about Cold War-style espionage and cyber conflict between states, cyber security problems European Union Institute for Security Studies April 2013 4 QN-AK-13-017-2A-N | ISSN 2315-1110 are expected to grow worse and are unlikely to be addressed through multilateral fora. Problems with hackers of various types make problems of attribution, response and coordination of policing very difficult. Cyber conflict involving states will ebb and flow along with the quality of the relationship between those states and competing states will continue to test each other’s cyber defences.

**No forum shopping – deregulated states will use international backchannels to regulate**

**von der Dunk 12** [(Frans G., Othmer Professor of Space Law, University of NebraskaLincoln, College of Law, LL.M. Programme in Space, Cyber and Telecommunications Law) "Towards 'Flags of Convenience' in Space?" Space, Cyber, and Telecommunications Law Program Faculty Publications. 76. <http://digitalcommons.unl.edu/spacelaw/76>] TDI

The above analyses have demonstrated that the dozen or so existing national space laws handling private involvement in space activities, notably their liability- and insurancerelated consequences, have so far done so in varying fashion. To start with in theory, that might lead to certain (prospective) operators making a rather judicious choice regarding which regime they might wish to be licensed under, as presenting them with the leastcostly set of obligations, requirements and standards – in other words, seeking a ‘flag of convenience’ to operate under.

This would assume of course, that such **operators would not even prefer to operate from jurisdictions** – including in terms of registration and headquartering, read nationality, of the actually operating company – **where as of yet no licensing system has been developed specifically for private space activities, and hence no dedicated reimbursement or insurance obligations exist.**

Whilst, however, prima facie that might seem to be an attractive option, any operator following such route should realise that, if causing damage covered by the Liability Convention and their government being consequently responsible and/or liable at the international level, such a government would in view of the specifics of the space sector and the likely enormous damages involved try to use every legal tool (such as general tort law, due diligence or wrongful act concepts) at its disposal to have international claims reimbursed after all – without any of the legal transparency and clarity that a license would have provided.

Of course, from the mere fact that national laws and licensing regimes are different it can not automatically be concluded that there is a risk in practice for ‘flags of convenience’ in outer space to become a real problem, so as to require or justify substantial efforts to deal with it for example at the UN level.

**Warming**

**No warrant for opportunity cost – we don't know where those investments otherwise would be going**

**Emissions reductions causes an immediate uptick in warming – much faster than CO2 reductions solve.**

**Samset, PhD, and Yale, ‘18** (Bjørn H, **PhDNuclearPhysics@Oslo**, Yale Environment 360, https://e360.yale.edu/features/air-pollutions-upside-a-break-on-global-warming, March 08) BW

Pollution particles emitted by diesel cars and trucks, coal-fired power plants, factories, rudimentary cook stoves, and the burning of forests are major contributors to the unhealthy pall of smog that blankets many cities and regions, particularly in the developing world. Scientists have long known that these aerosols serve to block incoming solar radiation and temporarily cool the planet, but now an international team of scientists has quantified that cooling effect, saying **the earth would be 0.5 to 1.1 degree C** (0.9 to 2 degrees F) **warmer if that pollution were to suddenly disappear.** In an interview with Yale Environment 360, lead author Bjørn H. Samset of Norway’s Center for International Climate Research discusses the implications of this research. As countries like China make progress in reducing air pollution, regional planners should be prepared for the cleaner air to cause a jump in temperatures even above those expected under global warming scenarios. At the same time, Samset says, rising temperatures will likely lead to an increase in precipitation as more water evaporates from oceans, lakes, and rivers. In Samset’s view, the recent findings should not be taken as a green light to ramp up controversial geoengineering efforts to spray aerosols into the atmosphere, a prospect he likens to Russian roulette. “In Russian roulette, you know there’s a bullet in there,” Samset told Yale 360. In the case of geoengineering, “there might not be a bullet, you might be lucky. But would you count on it? The precautionary principle argues against it.” Yale Environment 360: With these aerosols, is particle size important? Bjørn Samset: Yes, it is. The thing that connects all aerosols is that they are all of a size that is relevant for interaction with sunlight. The reactions with sunlight — the scattering of sunlight which leads to a cooling effect — become stronger as the aerosols grow, at least up to a certain size. For the **sulfate aerosols**, for instance, they tend to grow in humid air as water molecules and droplets tack onto them. The longer they are in the atmosphere, the stronger their effect becomes. There is a time element with aerosols after they are emitted, and that is where some of the detailed science is going at the moment — into tracking the evolution of these particles in the air over time. e360: How does the presence of these particles impact climate? Samset: They act as mirrors or as miniature clouds, and **they reflect the sunlight back into space.** So if the earth was surrounded with these aerosols, a lot of the sunlight would reflect back out and you would get cooling. That is exactly what we see. We believe that the volume of human-created aerosols is so great that they have **counteracted the effect of global warming** to a certain extent. There is a kind of tug of war taking place between the warming greenhouse gases and the mainly cooling aerosols. e360: That is ironic — pollution is actually slowing down global warming. Samset: Yes, it turns out we have actually been helping ourselves — we’ve been polluting ourselves toward a slightly cooler climate, we’ve been mitigating climate change through pollution. e360: How big a thermal effect do anthropogenic aerosols produce? Samset: We think that sulfate is cooling by half a degree or maybe a bit more. So this is the cause of some concern **if we clean up air pollution,** as we will do, then this impact on temperature will come very rapidly as opposed to greenhouse gases, where the impact of reducing them is felt much more slowly. e360: When you say that aerosols have led to at least half a degree Celsius of cooling, that is over how many years? Samset: That is the interesting thing about aerosols. We are used to thinking in terms of greenhouse gases, where you emit **CO2**, for example, and it just **stays up there for a long, long time.** But that’s not true of aerosols. If we were to stop emitting them today, then **in a week there would be no aerosols in the sky,** it would all rain out. It’s a continual process, which in a sense makes it a bit easier to treat than greenhouse gases. e360: If we were to end all pollution today, how much more of an effect would that have? Samset: That’s what we tried to find out in the paper that came out earlier this year — we turned off all anthropogenic aerosol emissions from all over the world. So **if you removed all our emissions today, then the world would rapidly — within a year or two — warm between a half of a degree and 1 degree Celsius additionally.** e360: We can see the cooling effect of aerosols in the atmosphere perhaps most dramatically in massive volcanic eruptions, which can alter the earth’s weather for years. What is the difference between the impact of a volcanic eruption and that of anthropogenic aerosols? Samset: Very little, except that a powerful volcano like Mount Pinatubo will emit mostly sulfate at very high altitudes — they will go 20 or 30 kilometers straight up all the way to the stratosphere, where they stay for a long time. Many of the particles remain above the layers of the atmosphere where rain is created, so it stays there for several years. e360: We’ve certainly known about the impact of aerosols on climate for a long time. But my perception is that there was not a lot of attention paid to them until recently. Samset: That’s true. Some years ago we thought that aerosols were interesting for people like me who like to study them, but not so important on the global scale, because it is really the greenhouse gases that matter. And that may be true. But then the Paris Agreement came around and it looked like there was momentum to keep the world below 2 degrees C of warming. So suddenly this half to 1 degree of cooling from aerosols — that actually begins to matter a lot more in the context of what we’re aiming for. So the aerosols have gone from being a perturbation to being actually very relevant because of our more ambitious climate goals.

**No extreme weather**

**Bezdek, PhD, and Monckton, MA, 18**

(Roger, Econ@Illinois, Christopher, BrittishRoyalty, Classics@Cardiff, Climate Change Reconsidered II: Fossil Fuels, NIPCC, Ch.8, p. 632-635, Contributors: Joseph Bast, FormerPresident@HeartlandInstitute, Barry Brill, FormerNewZealandParliment, OPM@HarvardBusiness, Kevin Dayaratna, PhD Stas@Maryland, Brian Leyland, MSc PowerSystemDesign@UniveristyOfAston)

Extreme Weather According to the IPCC, “sea level rise and increased frequency of extreme events increases the risk of loss of lives, homes, and properties, and damages infrastructure and transport systems” (IPCC, 2014, Table 12-1, p. 761). But as reported in Chapter 2, Section 2.3.1, researchers have failed to find a convincing relationship between higher surface temperatures over the past 100 years and increases in the frequency or severity of extreme weather events (Maue, 2011; Alexander et al., 2006; Khandekar, 2013; Pielke Jr., 2013, 2014). Instead, the number and intensity of extreme events wax and wane often in parallel with natural decadal or multidecadal climate oscillations. Legates (2014) writes, “Current state-of-the-art General Circulation Models (GCMs) do not simulate precipitation well because they do not include the full range of precipitation-forming mechanisms that occur in the real world. It is demonstrated here that **the impact of these errors are not trivial** – an error of only 1 mm in simulating liquid rainfall is equivalent to the energy required to heat the entire troposphere by 0.3°C. Given that models exhibit differences between the observed and modeled precipitation that often exceed 1 mm day, this lost energy is not trivial. Thus, models and their prognostications are largely unreliable” (abstract). Basic meteorological science suggests a warmer world would experience fewer storms and weather extremes, as indeed has been the case in recent years. Khandekar and Idso concluded, “It is clear in almost every instance of each extreme weather event examined, there is little support for predictions that CO2-induced global warming will increase either the frequency or intensity of those events. **The realworld data overwhelmingly support an opposite conclusion:** Weather will more likely be less extreme in a warmer world (Khandekar and Idso, p. 810).

**Extinction from warming requires 12 degrees**

**Farquhar 17** [(Sebastian, leads the Global Priorities Project (GPP) at the Centre for Effective Altruism) “Existential Risk: Diplomacy and Governance,” 2017, <https://www.fhi.ox.ac.uk/wp-content/uploads/Existential-Risks-2017-01-23.pdf>] TDI

The **most likely** levels of global warming are **very unlikely to cause human extinction**.15 The existential risks of climate change instead stem from tail risk climate change – the **low probability** of extreme levels of warming – and interaction with other sources of risk. It is impossible to say with confidence at what point global warming would become severe enough to pose an existential threat. Research has suggested that **warming of 11-12°C** would render most of the planet uninhabitable,16 and would completely devastate agriculture.17 This would pose an extreme threat to human civilisation as we know it.18 Warming of around 7°C or more could potentially produce conflict and instability on such a scale that the indirect effects could be an existential risk, although it is extremely uncertain how likely such scenarios are.19 Moreover, the timescales over which such changes might happen could mean that **humanity is able to adapt** enough to avoid extinction in **even very extreme scenarios**. The probability of these levels of warming depends on eventual greenhouse gas concentrations. According to some experts, unless strong action is taken soon by major emitters, it is likely that we will pursue a medium-high emissions pathway.20 If we do, the chance of extreme warming is highly uncertain but appears non-negligible. Current concentrations of greenhouse gases are higher than they have been for hundreds of thousands of years,21 which means that there are significant unknown unknowns about how the climate system will respond. Particularly concerning is the risk of positive feedback loops, such as the release of vast amounts of methane from melting of the arctic permafrost, which would cause rapid and disastrous warming.22 The economists Gernot Wagner and Martin Weitzman have used IPCC figures (which do not include modelling of feedback loops such as those from melting permafrost) to estimate that if we continue to pursue a medium-high emissions pathway, the probability of eventual warming of 6°C is around **10%**,23 and of 10°C is around **3%**.24 These estimates are of course **highly uncertain**. It is **likely** that the world will take action against climate change once it begins to impose large costs on human society, **long before there is warming of 10°C**. Unfortunately, there is significant inertia in the climate system: there is a 25 to 50 year lag between CO2 emissions and eventual warming,25 and it is expected that 40% of the peak concentration of CO2 will remain in the atmosphere 1,000 years after the peak is reached.26 Consequently, it is impossible to reduce temperatures quickly by reducing CO2 emissions. If the world does start to face costly warming, the international community will therefore face strong incentives to find other ways to reduce global temperatures.

**Ozone impact is hype – emissions not key, ozone hole not dangerous**

**Ridley 14** -- Matthew White Ridley, 5th Viscount Ridley DL FRSL FMedSci, known commonly as Matt Ridley, is a British journalist, businessman and author of popular science books. Since 2013 Ridley has been a Conservative hereditary peer in the House of Lords. “THE OZONE HOLE WAS EXAGGERATED AS A PROBLEM” http://www.rationaloptimist.com/blog/the-ozone-hole-was-exaggerated-as-a-problem.aspx

**Serial hyperbole does the environmental movement no favours** My recent [Times column](http://www.thetimes.co.uk/tto/opinion/columnists/article4206440.ece) argued that the alleged healing of the ozone layer is exaggerated, but so was the impact of the ozone hole over Antarctica: The ozone layer is healing. Or so said the news last week. Thanks to a treaty signed in Montreal in 1989 to get rid of refrigerant chemicals called chlorofluorocarbons (CFCs), the planet’s stratospheric sunscreen has at last begun thickening again. Planetary disaster has been averted by politics. For reasons I will explain, this news deserves to be taken with a large pinch of salt. You do not have to dig far to find evidence that the ozone hole **was never nearly as dangerous as** some **people said**, that it is not necessarily healing yet and that it might not have been caused mainly by CFCs anyway. The timing of the announcement was plainly political: it came on the 25th anniversary of the treaty, and just before a big United Nations climate conference in New York, the aim of which is to push for a climate treaty modelled on the ozone one. Here’s what was actually announced last week, in the words of a Nasa scientist, Paul Newman: “From 2000 to 2013, ozone levels climbed 4 per cent in the key mid-northern latitudes.” That’s a pretty small change and it is in the wrong place. The ozone thinning that worried everybody in the 1980s was over Antarctica. Over northern latitudes, ozone concentration has been falling by about 4 per cent each March before recovering. Over Antarctica, since 1980, the ozone concentration has fallen by [40 or 50 per cent each September](http://bigstory.ap.org/article/scientists-say-ozone-layer-recovering) before the sun rebuilds it. So what’s happening to the Antarctic ozone hole? Thanks to a diligent blogger named Anthony Watts, I came across a press release also from Nasa about nine months ago, which said: “ [Two new studies show](http://wattsupwiththat.com/2014/09/12/is-the-atmospheric-ozone-recovery-real-or-just-for-scoring-political-points/) that signs of recovery are not yet present, and that temperature and winds are still driving any annual changes in ozone hole size.” As recently as 2006, Nasa announced, quoting Paul Newman again, that the Antarctic ozone hole that year was “the largest ever recorded”. The following year a paper in Nature magazine from Markus Rex, a German scientist, presented new evidence that suggested CFCs may be responsible for less than 40 per cent of ozone destruction anyway. Besides, nobody knows for sure how big the ozone hole was each spring before CFCs were invented. All we know is that it varies from year to year. How much damage did the ozone hole ever threaten to do anyway? It is fascinating to go back and read what the usual hyperventilating eco-exaggerators said about ozone thinning in the 1980s. As a result of the extra ultraviolet light coming through the Antarctic ozone hole, southernmost parts of Patagonia and New Zealand see about 12 per cent more UV light than expected. This means that the weak September sunshine, though it feels much the same, has the power to cause sunburn more like that of latitudes a few hundred miles north. **Hardly Armageddon**. The New York Times reported “an increase in Twilight Zone-type reports of sheep and rabbits with cataracts” in southern Chile. Not to be outdone, Al Gore wrote that “hunters now report finding blind rabbits; fisherman catch blind salmon”. Zoologists briefly blamed the near extinction of many amphibian species on thin ozone. [Melanoma in people](http://www.wunderground.com/resources/climate/holefaq.asp?MR=1) was also said to be on the rise as a result. This was nonsense. Frogs were dying out because of a fungal disease spread from Africa — nothing to do with ozone. Rabbits and fish blinded by a little extra sunlight proved to be as mythical as unicorns. An eye disease in Chilean sheep was happening outside the ozone-depleted zone and was caused by an infection called pinkeye — nothing to do with UV light. And melanoma incidence in people actually levelled out during the period when the [ozone got thinner](http://www.heritage.org/research/commentary/2007/09/ozone-the-hole-truth). Then remember that the ozone hole appears when the sky is dark all day, and over an uninhabited continent. Even if it persists into the Antarctic spring and spills north briefly, the hole allows 50 times less ultraviolet light through than would hit your skin at the equator at sea level (let alone at a high altitude) in the tropics. So it would be bonkers to worry about UV as you sailed round Cape Horn in spring, say, but not when you stopped at the Galapagos: the skin cancer risk is 50 times higher in the latter place. This kind of eco-exaggeration has been going on for 50 years. In the 1960s Rachel Carson said there was an epidemic of childhood cancer caused by DDT; it was not true — DDT had environmental effects but did not cause human cancers.

**Debris**

**Debris and long standing legal framework promote restraint in outer space**

**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>]

A. 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.

**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.

**Uncertainty from debris collisions creates restraint not instability BUT the aff’s reduction greenlights space war**

**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.

**Satellites are crucial for large, industrial megafarms**

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Agriculture

To feed the Earth's growing population affordably, farming has gone from a **mostly decentralized, family-owned business** to **corporate farming** on a **scale** never before imagined. These **industrial megafarms** are a primary reason that many people in the world can enjoy plentiful and varied foods at a reasonable cost. On this scale, deciding what crop to plant in a given field is not just business - it's science. And the science **relies**, in large part, on **data from space**.

Companies such as the Satellite Imaging Corporation (SIC) provide data from space on overall crop health, soil analysis, and irrigation impacts and efficiencies. From space, you can easily map soil variations, finding areas rich in organic matter and others less so - this allows optimized planting to take advantage of crops that thrive in any given soil environment. **Very large** farms also use satellite images to assess the overall health of their crops by land area, spotting those that are being impacted by non-optimal soil moisture content, etc., allowing the farmer to take corrective action while there is still time to save the crop.

**Industrial ag’s unsustainable and causes extinction**

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We hear a lot about how we’re running out of antibiotics. But we are also doomed to run out of pesticides, because insects **inevitably** develop resistance, whether toxic chemicals are sprayed directly or genetically engineered into the plants.

Worse yet, weeds, insects, and fungus develop resistance in **just 5 years** on average, which has caused the chemicals to grow increasingly lethal over the past 60 years. And it takes on average eight to ten years to identify, test, and develop a new pesticide, though that isn’t long enough to discover the long-term toxicity to humans and other organisms.

And this devil’s bargain hasn’t even provided most of the gains in crop yields, which is due to natural-gas and phosphate fertilizers plus soil-crushing tractors and harvesters that can do the work of millions of men and horses quickly on farms that grow only one crop on thousands of acres.

Yet before pesticides, farmers lost a third of their crops to pests, after pesticides, farmers still lose a third of their crops.

Even without pesticides, **industrial agriculture is doomed to fail** from extremely high rates of soil erosion and soil compaction at rates that far exceed losses in the past, since soil couldn’t wash or blow away as easily on small farms that grew many crops.

But pest killing chemicals are surely **accelerating the day of reckoning** sooner rather than later. Enormous amounts of toxic chemicals are dumped on land every year — over **1 billion pounds** are used in the United State (US) every year and 5.6 billion pounds globally (Alavanja 2009).

This **destroys the very ecosystems** that used to help plants fight off pests, and is a **major factor** biodiversity loss and **extinction**.

Evidence also points to pesticides playing a **key role in the loss of bees** and their pollination services. Although paleo-diet fanatics won’t mind eating mostly meat when fruit, vegetable, and nut crops are gone, they will not be so happy about having to eat more carbohydrates. Wheat and other grains will still be around, since they are wind-pollinated.

Agricultural chemicals **render land lifeless** and toxic to beneficial creatures, also **killing the food chain above** — fish, amphibians, birds, and **humans** (from cancer, chronic disease, and suicide).

Surely a day is coming when pesticides stop working, resulting in **massive famines**. But who is there to speak for the grandchildren? And those that do speak for them are mowed down by the logic of libertarian capitalism, which only cares about profits today. Given that a political party is now in power in the U.S. that wants to get rid of the protections the Environmental Protection Agency (EPA) and other agencies provide, may make matters worse if agricultural chemicals are allowed to be more toxic, long-lasting, and released earlier, before being fully tested for health effects.

Meanwhile chemical and genetic engineering companies are making a fortune, because the farmers have to pay full price, since the pests develop resistance long before a product is old enough to be made generically. Except for glyphosate, but weeds have developed resistance. Predictably.

In fact, the inevitability of resistance has been known for nearly seven decades. In 1951, as the world began using synthetic chemicals, Dr. Reginald Painter at Kansas State University published “Insect Resistance in Crop Plants”. He made a case that it would be better to understand how a crop plant fought off insects, since it was inevitable that insects would develop genetic or behavioral resistance. At best, chemicals might be used as an emergency control measure.

Farmers will say that we simply must carry on like this, there’s no other choice. But that’s simply not true.

Consider the corn rootworm, that costs farmers about $2 billion a year in lost crops despite spending hundreds of millions on chemicals and the hundreds of millions of dollars chemical companies spend developing new chemicals.

To lower the chances of corn pests developing resistance, corn crops were rotated with soybeans. Predictably, a few mutated to eat soybeans plus changed their behavior. They used to only lay eggs on nearby corn plants, now they disperse to lay eggs on soybean crops as well. Worse yet, corn is more profitable than soy and many farmers began growing continuous corn. Already the corn rootworm is developing resistance to the latest and greatest chemicals.

But the corn rootworm is not causing devastation in Europe, because farms are smaller and most farmers rotate not just soy, but wheat, alfalfa, sorghum and oats with corn (Nordhaus 2017).

Before planting, farmers try to get rid of pests that survived the winter and apply fumigants to kill fungi and nematodes, and pre-emergent chemicals to reduce weed seeds from emerging. Even farmers practicing no-till farming douse the land with herbicides by using GMO herbicide-resistant crops. Then over the course of crop growth, farmers may apply several rounds of additional pesticides to control different pests. For example, cotton growers apply chemicals from 12 to 30 times before harvest.

Currently, the potential harm is only assessed for 2 to 3 years before a permit is issued, even though the damage might occur up to 20 years later.

Although these chemicals appear to be just like antibiotics, that isn’t entirely true. We develop some immunity to a disease after antibiotics help us recover, but a plant is still vulnerable to the pests and weeds with the genetics or behavior to survive and chemical assault.

Although there are thousands of chemical toxins, what matters is how they kill, their method of action (MOA). For herbicides there are only 29 MOAs, for insecticides, just 28. So if a pest develops resistance to one chemical within an MOA, it will be resistant to all of the thousands of chemicals within that MOA.

The demand for chemicals has also grown due the high level of bioinvasive species. It takes a while to find native pests and make sure they won’t do more harm than good. In the 1950s there were just three main corn pests. By 1978 there were 40, and they vary regionally. For example, California has 30 arthropods and over 14 fungal diseases to cope with.

When I was learning how to grow food organically back in the 90s, I remember how outraged organic farmers were that Monsanto was going to genetically engineer plants to have the Bt bacteria in them. This is because the only insecticide organic farmers can use is Bt bacteria, because it is found in the soil. It’s natural. Organic farmers have been careful to spray only in emergencies so that insects didn’t develop resistance to their only remedy. Since 1996, GMO plants have been engineered to have Bt in them, and predictably, insects have developed resistance. For example, in 2015, 81% of all corn was planted with genetically engineered Bt. But corn earworms have developed resistance, especially in North Carolina and Georgia, setting the stage for damage across the nation. Five other insects have developed resistance to Bt as well.

GMO plants were also going to reduce pesticide use. They did for a while, but not for long. Chemical use has increased 7% to 202,000 tons a year in the past 10 years.

Resistance can come in other ways than mutations. Behavior can change. Cockroach bait is laced with glucose, so cockroaches that developed glucose-aversion now no longer take the bait.

It is worth repeating that chemicals and other practices are ruining the long-term viability of agriculture. Here is how author Dyer explains it:

“Ultimately the practice of modern farming is **not sustainable**” because “the damage to the soil and natural ecosystems is so great that farming becomes dependent not on the land but on the artificial inputs into the process, such as fertilizers and pesticides. In many ways, our battle against the diverse array of pest species is a battle against the health of the system itself. As we kill pest species, we also kill related species that may be beneficial. We kill predators that could assist our efforts. We reduce the ecosystem’s ability to recover due to reduced diversity, and we interfere with the organisms that affect the biogeochemical processes that maintain the soils in which the plants grow.

Soil is a complex, multifaceted living thing that is far more than the sum of the sand, silt, clay, fungi, microbes, nematodes, and other invertebrates. All biotic components interact as an ecosystem within the soil and at the surface, and in relation to the larger components such as herbivores that move across the land. Organisms grow and dig through the soil, aerate it, reorganize it, and add and subtract organic material. Mature soil is structured and layered and, very importantly, it remains in place. Plowing of the soil turns everything upside down. What was hidden from light is exposed. What was kept at a constant temperature is now varying with the day and night and seasons. What cannot tolerate drying conditions at the surface is likely killed. And very sensitive and delicate structures within the soil are disrupted and destroyed.

Conventional tillage disrupts the **entire soil ecosystem**. Tractors and farm equipment are large and heavy; they compact the soil, which removes air space and water-holding capacity. Wind and water erosion remove the smallest soil particles, which typically hold most of the micronutrients needed by plants. Synthetic fertilizers are added to supplement the loss of oil nutrients but often are relatively toxic to many soil organisms. And chemicals such as pre-emergents, fumigants, herbicides, insecticides, acaricides, fungicides, and defoliants eventually kill all but the most tolerant or resistant soil organisms. It does not take long to reduce a native, living, dynamic soil to a relatively **lifeless collection** of inorganic particles with little of the natural structure and function of undisturbed soil”.

When I told my husband all the reasons we use agricultural chemicals and the harm done, my husband got angry and said “Farmers aren’t stupid, that can’t be right!”

I think there are a number of reasons why farmers don’t go back to sustainable organic farming.

First, there is far too much money to be made in the chemical herbicide, pesticide, and insecticide industry to stop this juggernaut. After reading Lessig’s book “Republic, Lost”, one of the best, if not the best book on campaign finance reform, I despair of campaign financing ever happening. So chemical lobbyists will continue to donate enough money to politicians to maintain the status quo. Plus the chemical industry has infiltrated regulatory agencies via the revolving door for decades and is now in a position to assassinate the EPA, with newly appointed Scott Pruitt, who would like to get rid of the EPA.

Second, about half of farmers are hired guns. They don’t own the land and care about passing it on in good health to their children. They rent the land, and their goal, and the owner’s goal is for them to make as much profit as possible.

Third, renters and farmers both would lose money, maybe go out of business in the years it would take to convert an industrial monoculture farm to multiple crops rotated, or an organic farm.

Fourth, it takes time to learn to farm organically properly. So even if the farmer survives financially, mistakes will be made. Hopefully made up for by the higher price of organic food, but as wealth grows increasingly more unevenly distributed, and the risk of another economic crash grows (not to mention lack of reforms, being in more debt now than 2008, etc).

Fifth, industrial farming is what is taught at most universities. There are only a handful of universities that offer programs in organic agriculture.

Sixth, subsidies favor large farmers, who are also the only farmers who have the money to profit from economies of scale, and buy their own giant tractors to farm a thousand acres of monoculture crops. Industrial farming has driven 5 million farmers off the land who couldn’t compete with the profits made by larger farms in the area.

But farmers will have to go organic **whether they like it or not**

It’s hard to say whether this will happen because we’ve **run out** of pesticides, whether from **resistance** or a **financial crash** reducing new chemical research, or whether peak oil, peak coal, and peak natural gas will cause the decline of chemical farming. Agriculture uses about 15 to 20% of fossil fuel energy, from natural gas fertilizer, oil-based chemicals, farm vehicle and equipment fuel, the agricultural cold chain, distribution, packaging, refrigeration, and cooking to name a few of the uses.

At some point of fossil decline, **there won’t be enough fuel or pesticides** to continue business as usual.

Farmers will be **forced** to go organic at some point. Wouldn’t it be easier to start the transition **now**?

**Loss of satellites shuts down drones**

Daniel **Ventre 11**, Engineer for CNRS and Researcher for CESDIP, Cyberwar and Information Warfare, p. 198-199

The introduction of cyberspace operations is part of a specific context; a major evolution in the operation environment and the nature of the conflicts, which make irregular wars the rule, and make regular actors the exception to the rule. But the battle against unconventional, non-state governed, irregular actors raises specific problems: there are multiple actors, unpredictable at that, who do not abide by the same rules. New orders in conflicts are imposing the implementation of an ever more important need for information, and information collection and processing. Networks now have an **incredible importance**. The document refers to the growing threats against American heritage: the USA is a target and the increasing amount of attacks against their networks is indeed the proof of this. There are many obstacles which need to be removed before they can achieve real superiority and freedom to act, especially as vulnerable points may originate within the very operations of the armed forces. An example of this is the vulnerability of using products (software and hardware), commercial products (off-the-shelf), and sometimes even foreign products123. This brings to mind the fact that the US Air Force uses commercial, even foreign, applications for its cyberspace operations.

Information space extends to space124, particularly via communication and observation satellites125. Satellites are the keystone to the cyberspace and communication systems, but also the security system: monitoring (Echelon network is the symbol), observation, communication. These are at the heart of the C4ISR systems, without which a concept such as network-centric warfare could not exist. **There would be no drones without satellites**. It is even a question of extending the Internet to extra-atmospheric space. Projects in this vein (Interplanetary Networks) were being formed in the 1990s, but ran into several technical difficulties (delays in important transmissions due to high distances and costs) [GEL 06]. NASA dedicates a few pages on its website to this project126. The development of communication systems based on the infrastructures in extra-atmospheric space will also raise questions for legal, geopolitical and geostrategic domains: questions of seizing this space, questions of regulation of human activity in this space, of sovereignty, new territoriality and independence.

**Drone prolif is inevitable and causes global nuclear war**

Dr. Michael C. **Horowitz 19**, Professor of Political Science at University of Pennsylvania, NDT Champion from Emory University, PhD in Government from Harvard University, Adjunct Senior Fellow at the Center for a New American Security, “When Speed Kills: Autonomous Weapon Systems, Deterrence, and Stability”, 5/2/2019, https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3348356

Thus, the reason to deploy autonomous systems would have to be their reliability and effectiveness rather than signaling. And giving up human control to algorithms in a crisis that could end with **global nuclear war** would require an extremely high level of perceived reliability and effectiveness. Few things are more important to militaries in crisis situations than informational awareness and control over decisions, and there might be fear that autonomous systems are prone to **accidents**.

This counterfactual illustrates that the development and deployment of lethal autonomous weapon systems by national militaries, if it occurs, is unlikely to have simple, easy, and linear consequences. Instead, human factors, including the psychological desire for control and organizational politics, will strongly shape how militaries think about developing and using LAWS. This will not just influence the potential for arms races in peacetime, but deterrence and wartime stability due to the organizational processes militaries implement for the deployment and use of autonomous systems on the battlefield.

This paper draws on research in strategic studies and examples from military history to assess how LAWS could influence the development and deployment of military systems, including **arms races**, **crisis stability**, and wartime stability, especially the risk of **escalation**. It also discusses the potential for arms control. It focuses on these questions through the lens of key characteristics of LAWS, especially the potential for increased operational speed and, simultaneously, less human control over battlefield choices. One of the primary attractions of autonomous systems, even compared to remotely piloted systems, is the potential to operate at machine speed. Another potential benefit is the possibility of machine-like accuracy in following programming, but that comes with a potential downside: the loss of control and the accompanying risk of **accidents**, adversarial **spoofing**, and **miscalculation**. Even if LAWS malfunction at the same rate as humans in a given scenario, the ability of operators to control the impact of those malfunctions may be lower, which could make LAWS less predictable on the battlefield. The paper then examines how these issues interact with the large uncertainty parameter associated with AI-based military capabilities at present, both in terms of the range of the possible and the opacity of their programming.

The results highlight several critical issues surrounding the development and deployment of LAWS.1 First, the desire to fight at machine speed with autonomous systems, while making a military more effective in a conflict, could increase **crisis instability**. As countries fear losing conflicts faster, it will generate **escalation pressure**, including an increased incentive for **first strikes**. Second, in addition to the actual risk of accidents and miscalculation from LAWS, the fear of accidents and losing control of autonomous systems could limit the willingness of militaries to deploy them, particularly since many militaries are conservative when it comes to emerging technologies and have high standards for system reliability. Third, the dual-use, or even general purpose, character of the basic science underlying many autonomous systems will make the technology hard to control, giving many countries and actors access to basic algorithms, though whether this is described as diffusion, proliferation, or an arms race will depend on political dynamics as much as anything.

Finally, multiple uncertainty parameters concerning lethal autonomous weapon systems could exacerbate **security dilemmas**.

Uncertainty over the range of the possible concerning the programming of lethal autonomous weapon systems will increase fear of those systems in the near term, making restraint less likely for competitive reasons. Moreover, the inherent differences between remotely piloted systems and LAWS at the platform level come from software, not hardware. There is arguably an inherent opacity to lethal autonomous weapon systems. If an arms race over lethal autonomous weapon systems occurs, it will likely be because of worse-case assumptions about capability development by potential adversaries.

What is Autonomy or Artificial Intelligence?

Artificial intelligence is the use of computing power, in the form of algorithms, to conduct tasks that previously required human intelligence.2 Artificial intelligence in this context is best thought of as an umbrella technology or enabler, like the combustion engine or electricity. Military applications of artificial intelligence are potentially broad – from image recognition for surveillance to more efficient logistics to battle management.3 These include both non-kinetic applications, including in the cyber realm, as well as kinetic applications.4 One potential application of artificial intelligence is through armed autonomous systems that could be deployed on the battlefield, or what are most popularly called lethal autonomous weapon systems or lethal autonomous weapon systems. This differs from remotely-piloted systems where a human, though at a distance, still operates a given vehicle or system.

What is a lethal autonomous weapon system? While simple to describe on first glance, and easy to understand in the extreme – an armed humanoid robot with extremely broad programming making decisions about engaging in warfare – drawing the line between a lethal autonomous weapon system and other weapon systems is complex. In Directive 3000.09, published in 2012, the US Department of Defense defines an autonomous weapon as “A weapon system that, once activated, can select and engage targets without further intervention by a human operator.”5 What it means to select and engage a target is not entirely clear, however. For example, homing munitions, which have existed since World War II, select and engage targets, according to a common sense understanding of the terms.6

Exactly what functions are autonomous also matters. A system could have automatic piloting, for example, that flies or drives a platform to a target, but still have complete human control over the use of the weapon. That would be a system with a high level of automation, though not a lethal autonomous weapon system according to most perspectives. Heather Roff measures the level of autonomy in a weapon system based on three subcomponents: self-mobility, self-direction, and self-determination. This helps distinguish systems where there might be autonomy concerning the best way a missile should get to a target, but the target itself is designated by a person fromsystems where an algorithm might be making higher-level engagement decisions.7 There are already some applications of limited machine autonomy in military systems, with the most prominent example being the automatic mode present on many Close-In Weapon Systems (CIWS), such as the Phalanx, used to defend ships and incoming missiles from attack.8

This article will not resolve the definitional debate surrounding lethal autonomous weapon systems, which is still ongoing in meetings of the Group of Governmental Experts focused on lethal autonomous weapon systems in the United Nations Convention on Certain Conventional Weapons. Provisionally, this article adopts the Scharre and Horowitz definition that a lethal autonomous weapon system is “[A] weapon system that, once activated, is intended to select and engage targets where a human has not decided those specific targets are to be engaged.”9 However, moving beyond the close cases (e.g. particular types of missile guidance systems) and considering those weapon systems that clearly use machine intelligence to search for, select, and/or engage targets can help clarify what is at stake in this debate in the first place.10 After all, if most militaries most of the time would not have any need for lethal autonomous weapon systems, or those systems have significant disadvantages relative to remotely-piloted military robotics or soldiers on the battlefield, the stakes are lower. In contrast, if the integration of machine intelligence with military systems could give countries or violent non-state actors a significant advantage in how they employ force, it becomes even more crucial to engage the topic.

It is important to note that this article does not address concerns about existential risk related to artificial general intelligence – the fear that a superintelligence could decide to destroy the human race, either because it decides humans are malign or because humans program it to achieve a goal it can only accomplish by destroying humans.11 The existential risk issue associated with artificial intelligence is not necessarily closely coupled to military applications of artificial intelligence. If a super-intelligent machine learning system has the ability to take over human society in the interest of a goal – any goal – whether autonomous systems at much smaller orders of magnitude already exist in military systems will likely be unimportant. The super-intelligent system would simply create what it needed.

Why Invest in Autonomous Systems?

Militaries are already increasing their investments in remotely-piloted robotic systems. From UAVs such as the MQ-9 Reaper (**U**nited **S**tates) to uninhabited surface vehicles (USVs) such as the Guardium (**Israel**) to uninhabited ground vehicles (UGV) such as Platform-M (**Russia**), militaries **around the world** are investing in remotely piloted platforms, some of which can carry weapons. In these systems, human control over the use of force is not fundamentally different from the use of force with inhabited systems. In some cases, such as the MQ-9 Reaper, the sensor system a drone pilot uses to launch a weapon might even be the same sensor system a pilot in the cockpit of an inhabited fighter uses. Using remotely piloted systems gives militaries the ability to reduce the risk to their own soldiers while still projecting power in similar ways to how they used force previously.12 The first places militaries are likely to use kinetic lethal autonomous weapon systems include relatively “clear” environments such as air-to-air combat or naval combat, especially in geographic arenas where civilians are extremely unlikely to be present.13

**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.**

**Goes 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.