## 1NC – T

#### Interpretation: “Appropriation of outer space” by private entities refers to the exercise of exclusive control of space.

TIMOTHY JUSTIN TRAPP, JD Candidate @ UIUC Law, ’13, TAKING UP SPACE BY ANY OTHER MEANS: COMING TO TERMS WITH THE NONAPPROPRIATION ARTICLE OF THE OUTER SPACE TREATY UNIVERSITY OF ILLINOIS LAW REVIEW [Vol. 2013 No. 4]

The issues presented in relation to the nonappropriation article of the Outer Space Treaty should be clear.214 The ITU has, quite blatantly, created something akin to “property interests in outer space.”215 It allows nations to exclude others from their orbital slots, even when the nation is not currently using that slot.216 This is directly in line with at least one definition of outer-space appropriation.217 [\*\*Start Footnote 217\*\*Id. at 236 (“Appropriation of outer space, therefore, is ‘the exercise of exclusive control or exclusive use’ with a sense of permanence, which limits other nations’ access to it.”) (quoting Milton L. Smith, The Role of the ITU in the Development of Space Law, 17 ANNALS AIR & SPACE L. 157, 165 (1992)). \*\*End Footnote 217\*\*]The ITU even allows nations with unused slots to devise them to other entities, creating a market for the property rights set up by this regulation.218 In some aspects, this seems to effect exactly what those signatory nations of the Bogotá Declaration were trying to accomplish, albeit through different means.219

#### Violation: constellations’ use of LEO does not exclusively occupy or preclude other orbits

Johnson 20 [(Christopher, Professor of Law at the Georgetown University Law Center, Adjunct Faculty at the International Space University in Strasbourg, France, the Legal Advisor for the Moon Village Association, Core Expert and Rule Drafter in the Manual on International Law Applicable to Military Activities in Outer Space project, Juris Doctor from New York Law School and an Advanced Masters in Law in Air and Space Law from Leiden University’s International Institute of Air and Space Law) “The Legal Status of MegaLEO Constellations and Concerns About Appropriation of Large Swaths of Earth Orbit,” Handbook of Small Satellites, 2020] JL

The use of LEO by satellite constellations is substantially similar to the use of GSO, and therefore permissible. In each region, individual actors are given permission - either from a national administrator or from an international governing body (the ITU) via a national administer–to use precoordinated subsections of space. In a way that is overwhelmingly similar to the use of orbital slots in GSO, the placement of spacecraft into orbits in LEO or higher orbits does not constitute possession, ownership, or occupation of those orbits. This is because States (and their companies) have been occupying orbital slots in GSO for decades, and these uses of GSO have never been accused of “appropriating” GSO. The users have never claimed to be appropriating GSO, and their exercising of rights to use GSO is respected by other actors in the space domain. This is the same situation for other orbits, including LEO and other non-Geostationary orbits. And while GSO locations are relatively stable (subject to space weather and other perturbations, and require stationkeeping), spacecraft in LEO are actually moving through space and are not stationary, so it is even more difficult to see this use by constellations as occupation, much less appropriation. Moreover, Space Situational Awareness (SSA) and Space Traffic Management (STM) will allow other uses to use these orbits, and nothing about the use of any one user necessarily precludes others. Lastly, there is no intention by operators of constellations to exclusively occupy, must less possess or appropriate, these orbits. Would not the appropriation of outer space be an intentional, volutional act? No such intention can be found in the operators of global constellations.

#### Net benefits:

#### Precision – their interp justifies jettisoning any word in the rez, like private actors and outer space which zeroes neg prep ­– proven by the absence of “appropriation” in the plan text

#### Limits – literally anything that takes place in space becomes topical under their interp – 2 physical entities can never occupy space at the same time – tourism, mining, constellations, rockets, skydiving, lunar bases, exploration, radio waves, photography – limits explosion precludes nuanced clash and privileges the aff by stretching pre-tournament neg prep too thin

#### Drop the debater – indicts the whole aff and deters abuse

#### Competing interps – reasonability invites arbitrary judge intervention and a race to the bottom

#### No RVIs – fairness and education are logical litmus tests and incentivizes baiting abuse to win on prepped out counterinterps

## 1NC – DA

#### China’s capitalizing on US vulnerabilities and ramping up satellite jamming capabilities – that emboldens Xi to invade Taiwan

Chow and Kelley 8/21 [(Brian G., policy analyst for the Institute of World Politics, Ph.D in physics from Case Western Reserve University, MBA and Ph.D in finance from the University of Michigan,and Brandon, graduate of Georgetown’s School of Foreign Service ) “China’s Anti-Satellite Weapons Could Conquer Taiwan—Or Start a War,” National Interest, 8/21/2021] JL

If current trends hold, then China’s Strategic Support Force will be capable by the late 2020s of holding key U.S. space assets at risk. Chinese military doctrine, statements by senior officials, and past behavior all suggest that China may well believe threatening such assets to be an effective means of deterring U.S. intervention. If so, then the United States would face a type of “Sophie’s Choice”: decline to intervene, potentially leading allies to follow suit and Taiwan to succumb without a fight, thereby enabling Xi to achieve his goal of “peacefully” snuffing out Taiwanese independence; or start a war that would at best be long and bloody and might well even cross the nuclear threshold.

This emerging crisis has been three decades in the making. In 1991, China watched from afar as the United States used space-enabled capabilities to obliterate the Iraqi military from a distance in the first Gulf War. The People’s Liberation Army quickly set to work developing capabilities targeted at a perceived Achilles’ heel of this new American way of war: reliance on vulnerable space systems.

This project came to fruition with a direct ascent ASAT weapons test in 2007, but the test was limited in two key respects. First, it only reached low Earth orbit. Second, it generated thousands of pieces of long-lasting space junk, provoking immense international ire. This backlash appears to have taken China by surprise, driving it to seek new, more usable ASAT types with minimal debris production. Now, one such ASAT is nearing operational status: spacecraft capable of rendezvous and proximity operations (RPOs).

Such spacecraft are inevitable and cannot realistically be limited. The United States, European Union, China, and others are developing them to provide a range of satellite services essential to the new space economy, such as in situ repairs and refueling of satellites and active removal of space debris. But RPO capabilities are dual-use: if a satellite can grapple space objects for servicing, then it might well be capable of grappling an adversary’s satellite to move it out of its servicing orbit. Perhaps it could degrade or disable it by bending or disconnecting its solar panels and antennas all while producing minimal debris.

This is a serious threat, primarily because no international rules presently exist to limit close approaches in space. Left unaddressed, this lacuna in international law and space policy could enable a prospective attacker to pre-position, during peacetime, as many spacecraft as they wish as close as they wish to as many high-value targets as they wish. The result would be an ever-present possibility of sudden, bolt-from-the-blue attacks on vital space assets—and worse, on many of them at once.

China has conducted at least half a dozen tests of RPO capabilities in space since 2008, two of which went on for years. Influential space experts have noted that these tests have plausible peaceful purposes and are in many cases similar to those conducted by the United States. This, however, does not make it any less important to establish effective legal, policy, and technical counters to their offensive use. Even if it were certain that these capabilities are intended purely for peaceful applications—and it is not at all clear that that is the case—China (or any other country) could at any time decide to repurpose these capabilities for ASAT use.

There is still time to get out ahead of this threat, but likely not for much longer. China’s RPO capabilities have, thus far, lagged about five years behind those of the United States. There are reasons to believe this gap may close, but even assuming that it holds, we should expect to see China demonstrate an operational dual-use rendezvous spacecraft by around 2025. (The first instance of a U.S. commercial satellite docking with another satellite to change its orbit occurred in February 2020.)

At the same time, China is expanding its capacity for rapid spacecraft manufacturing. The Global Times reported in January that China’s first intelligent mass production line is set to produce 240 small satellites per year. In April, Andrew Jones at SpaceNews reported that China is developing plans to quickly produce and loft a thirteen thousand-satellite national internet megaconstellation. It is not unreasonable to assume that China could manufacture two hundred small rendezvous ASAT spacecraft by 2029, possibly more.

If this happens, and Beijing was to decide in 2029 to launch these two hundred small RPO spacecraft and position them in close proximity to strategically vital assets, then China would be able to simultaneously threaten disablement of the entire constellations of U.S. satellites for missile early warning (about a dozen satellites with spares included); communications in a nuclear-disrupted environment (about a dozen); and positioning, navigation, and timing (about three dozen); along with several dozen key communications, imagery, and meteorology satellites. Losing these assets would severely degrade U.S. deterrence and warfighting capabilities, yet once close pre-positioning has occurred such losses become almost impossible to prevent. For this reason, such pre-positioning could conceivably deter the United States from coming to Taiwan’s aid due to the prospect that intervention would spur China to disable these critical space systems. Without their support, the war would be much bloodier and costlier—a daunting proposition for any president.

Should the United States fail to intervene, the consequences would be disastrous for both Washington and its allies in East Asia, and potentially the credibility of U.S. defense commitments around the globe. Worse yet, however, might be what could happen if China believes that such a threat will succeed but proves to be wrong. History is rife with examples of major wars arising from miscalculations such as this, and there are many pathways by which such a situation could easily escalate out of control to a full-scale conventional conflict or even to nuclear use.

#### Starlink development solves – mega-constellations are unjammable and accurate

Harris 20 [(Mark, Knight Science Journalism Fellow at MIT in 2013, writes about technology, science, business, the environment, and travel, internally cites Todd Humphreys, Professor of Aerospace Engineering at UT Austin, and Peter Iannucci,, Postdoctoral Research Fellow in Aerospace Engineering and Engineering Mechanics at UT Austin) “SpaceX’s Starlink satellites could make US Army navigation hard to jam,” MIT Technology Review, 9/28/2020] JL

Now, research funded by the US Army has concluded that the growing mega-constellation could have a secondary purpose: doubling as a low-cost, highly accurate, and almost unjammable alternative to GPS. The new method would use existing Starlink satellites in low Earth orbit (LEO) to provide near-global navigation services.

In a non-peer-reviewed paper, Todd Humphreys and Peter Iannucci of the Radionavigation Laboratory at the University of Texas at Austin claim to have devised a system that uses the same satellites, piggybacking on traditional GPS signals, to deliver location precision up to 10 times as good as GPS, in a system much less prone to interference.

The Global Positioning System consists of a constellation of around 30 satellites orbiting 20,000 kilometers above Earth. Each satellite continuously broadcasts a radio signal containing its position and the exact time from a very precise atomic clock on board. Receivers on the ground can then compare how long signals from multiple satellites take to arrive and calculate their position, typically to within a few meters.

The problem with GPS is that those signals are extremely weak by the time they reach Earth, and are easily overwhelmed by either accidental interference or electronic warfare. In China, mysterious GPS attacks have successfully “spoofed” ships in fake locations, while GPS signals are regularly jammed in the eastern Mediterranean.

The US military relies heavily on GPS. Last year, the US Army Futures Command, a new unit dedicated to modernizing its forces, visited Humphreys’s lab to talk about a startup called Coherent Navigation he had cofounded in 2008. Coherent, which aimed to use signals from Iridium satellites as a rough alternative to GPS, was acquired by Apple in 2015.

“They told me the Army has a relationship with SpaceX [it signed an agreement to test Starlink to move data across military networks in May] and would I be interested in talking to SpaceX about using their Starlink satellites the same way that I used these old Iridium satellites?” Humphreys says. “That got us an audience with people at SpaceX, who liked it, and the Army gave us a year to look into the problem.” Futures Command also provided several million dollars in funding.

The concept of using LEO satellites for navigation isn't new. In fact, some of the first US spacecraft launched in the 1960s were Transit satellites orbiting at 1,100 kilometers, providing location information for Navy ships and submarines. The advantage of an LEO constellation is that the signals can be a thousand times stronger than GPS. The disadvantage is that each satellite can serve only a small area beneath it, so that reliable global coverage requires hundreds or even thousands of satellites.

Building a whole new network of LEO satellites with ultra-accurate clocks would be an expensive undertaking. Bay Area startup Xona Space Systems plans to do just that, aiming to launch a constellation of at least 300 Pulsar satellites over the next six years.

Humphreys and Iannucci’s idea is different: they would use a simple software upgrade to modify Starlink’s satellites so their communications abilities and existing GPS signals could provide position and navigation services .

They claim their new system can even, counterintuitively, deliver better accuracy for most users than the GPS technology it relies upon. That is because the GPS receiver on each Starlink satellite uses algorithms that are rarely found in consumer products, to pinpoint its location within just a few centimeters. These technologies exploit physical properties of the GPS radio signal, and its encoding, to improve the accuracy of location calculations. Essentially, the Starlink satellites can do the heavy computational lifting for their users below.

The Starlink satellites are also essentially internet routers in space, capable of achieving 100 megabits per second. GPS satellites, on the other hand, communicate at fewer than 100 bits per second.

“There are so few bits per second available for GPS transmissions that they can’t afford to include fresh, highly accurate data about where the satellites actually are,” says Iannucci. “If you have a million times more opportunity to send information down from your satellite, the data can be much closer to the truth.”

The new system, which Humphreys calls fused LEO navigation, will use instant orbit and clock calculations to locate users to within 70 centimeters, he estimates. Most GPS systems in smartphones, watches, and cars, for comparison, are only accurate to a few meters.

But the key advantage for the Pentagon is that fused LEO navigation should be significantly more difficult to jam or spoof. Not only are its signals much stronger at ground level, but the antennas for its microwave frequencies are about 10 times more directional than GPS antennas. That means it should be easier to pick up the true satellite signals rather than those from a jammer.  “At least that’s the hope,” says Humphreys.

According to Humphreys and Iannucci’s calculations, their fused LEO navigation system could provide continuous navigation service to 99.8% of the world’s population, using less than 1% of Starlink’s downlink capacity and less than 0.5% of its energy capacity.

“I do think this could lead to a more robust and accurate solution than GPS alone,” says Todd Walter of Stanford University’s GPS Lab, who was not involved with the research. “And if you don’t have to modify Starlink’s satellites, it certainly is a fast, simple way to go.”

#### 1AC Zenko says Chinese ASAT tests create debris and cause miscalc – proves it’s try or die for Starlink deterrence – inserted in green

A January 2007 direct ascent ASAT test carried out by China against its defunct Fengyun-1C weather satellite instantly increased the amount of space debris in low earth orbit (LEO) by 40 percent. Debris is especially problematic in LEO, where half of the world's 1,100 active satellites operate. Space objects—even flecks of paint—travel as fast as eighteen thousand miles per hour and can cause catastrophic damage to manned and unmanned spacecraft—creating even more debris in the process. The U.S. National Research Council estimates that portions of LEO have reached a "tipping point," with hundreds of thousands of space debris larger than one centimeter stuck in orbit that will collide with other pieces of debris or spacecraft, thus creating exponentially more debris. Significant growth in the quantity or density of space debris could render certain high-demand portions of outer space unnavigable and inutile. Currently, there are no legal or internationally accepted means for removing existing debris. China could also test co-orbital antisatellite systems in which an interceptor spacecraft destroys its target by exploding in close proximity, creating even more debris. For several years, Beijing has conducted a series of close proximity maneuvers with its satellites in LEO; the most recent occurred after a July 20, 2013, launch of three satellites on the same rocket, which have since conducted sudden maneuvers toward other Chinese satellites. Human or operating errors during these maneuvers could inadvertently result in a collision that produces harmful debris. While these maneuvers could eventually be used for civilian purposes, most U.S. officials believe these experiments are primarily intended to demonstrate latent ASAT capabilities. An ASAT test that causes unintended damage to U.S. and ally satellites or an accident in space caused by debris could trigger a major international crisis between the United States and China. The risk is heightened by the fact that both countries have no pre–space-launch notification arrangements, similar to the U.S.-Russia agreement on notifications of intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM) launches. Management of such a crisis could also be hindered by a lack of direct communication between U.S. authorities and the PLA agency that oversees Chinese military space launches.

#### Taiwan goes nuclear – the US gets drawn in

The Week 1/4 [(The Week Staff, weekly news magazine with editions in the United Kingdom and United States) “What would happen if China tried to invade Taiwan?” The Week Staff, 1/4/2022] JL

If a conflict were to break out between the two neighbours it would be “a catastrophe”, reported The Economist. This is first because of “the bloodshed in Taiwan” but also because of the risk of “escalation between two nuclear powers”, namely the US and China.

Beijing massively outguns Taiwan, with estimates from the Stockholm International Peace Research Institute showing that China spends about 25 times more on its military. However, Taiwan has a defence pact with the US dating back to the 1954 Sino-American Mutual Defence Treaty, meaning the US could, in theory, be drawn into the conflict.

“Beijing’s optimistic version of events” after the decision to invade would see “cyber and electronic warfare units target Taiwan’s financial system and key infrastructure, as well as US satellites to reduce notice of impending ballistic missiles”, Bloomberg said.

“Chinese vessels could also harass ships around Taiwan, restricting vital supplies of fuel and food,” the news site continued, while “airstrikes would quickly aim to kill Taiwan’s top political and military leaders, while also immobilising local defences”.

This would be followed by “warships and submarines traversing some 130 kilometres [80 miles] across the Taiwan Strait”, before “thousands of paratroopers would appear above Taiwan’s coastlines, looking to penetrate defences [and] capture strategic buildings”.

According to satellite imagery seen by military news site The Drive, China has also begun “beefing up its combat aviation infrastructure across from Taiwan as invasion fears grow”.

Beijing “is upgrading three air bases located opposite” the island, “boosting its air power capability in an already tense region that is flush with air combat capabilities.”

“Construction of the new infrastructure began in early 2020 and continued uninterrupted through the pandemic, underlining its priority,” the site added.

Taiwan would be reliant on “natural defences” – its rugged coastline and rough sea – with plans to “throw a thousand tanks at the beachhead” in the event of a Chinese invasion that could result in “brutal tank battles” that “decide the outcome”, according to Forbes.

The island’s top military leadership has also “warned China that the closer its aircraft and ships get to the island the harder Taipei will respond”, Bloomberg reported, with “a multi-pronged approach that utilises aircraft, ships and its air defence systems to counter Chinese military incursions” in the works.

“Chinese state media has dismissed the idea of Taiwan retaliating,” the news agency added. But a report by the island’s defence ministry sent to legislators shows the island is preparing to “take tougher measures” should they be necessary.

This would all be complicated by the US pledge to defend its ally in what The Economist called a “test of America’s military might and its diplomatic and political resolve”.

Asked last week during a CNN town hall meeting whether the US would mount a military response if Beijing attempted to take the island by force, Biden responded: “Yes, we have a commitment to do that.”

The Guardian said that Biden “made a similar pledge in August”, when he told ABC News that the US has a “sacred commitment” to defend its Nato allies in Canada and Europe and it was the “same with Japan, same with South Korea, same with Taiwan”.

If the US had decided against intervention, “China would overnight become the dominant power in Asia” and “America’s allies around the world would know that they could not count on it”, the paper added. In other words, “Pax Americana would collapse”.

That would be unacceptable in Washington, especially as “Joe Biden pivots US foreign policy towards a focus on the Indo-Pacific as the main arena for 21st-century superpower competition”, The Guardian said.

Biden’s comments during the CNN event were “at odds with the long-held US policy” of “strategic ambiguity”, The Telegraph said. Historically, Washington has helped “build Taiwan’s defences” but has “not explicitly promised to come to the island’s aid”.

US manoeuvres have so far consisted of building up “large amounts of lethal military hardware”, The Guardian added, with “the steady buildup of troops and equipment and the proliferation of war games” meaning there is “more of a chance of conflict triggered by miscalculation or accident”.

The primary danger that comes with US involvement lies in the fact that both Washington and Beijing possess nuclear weapons.

Leaked documents published by The New York Times earlier this year revealed the extent of Washington’s discussions about using nuclear weapons to deter a Chinese invasion of Taiwan in the 1950s.

Provided to the paper by Daniel Ellsberg, the whistleblower behind the 1971 Pentagon Papers, the documents appeared to show an “acceptance by some US military leaders of possible retaliatory nuclear strikes on US bases”, CNN noted, raising the spectre of how the nuclear powers would square off in a 21st-century conflict.

## 1NC – CP

#### CP: Space-faring nations should

#### Establish a unified system of space traffic management modeled after the International Telecommunication Union

#### Collaborate on techniques to track and display the location of objects in real time and AI to automate debris-avoidance maneuvers

#### The United States Federal Government should:

#### Shift responsibility for the Space-Track catalogue to the civilian Department of Commerce, allocating necessary funds

Nature 8/11 [(Nature Editorial Board, peer-reviewed, comprises experimental scientists and data-standards experts from across different fields of science) “The world must cooperate to avoid a catastrophic space collision,” Nature, 8/11/2021] JL

But there are no traffic cops in space, nor international borders with clearly delineated areas of responsibility. To avoid further damage, it’s crucial that satellite operators have an accurate and up-to-date list of where objects are in space. At present, the main global catalogue of space objects is published at Space-Track.org by the US Space Command, a branch of the military. The catalogue is the most widely used public listing available, but it lacks some satellites that countries — including the United States, China and Russia — have not acknowledged publicly. In part because of this lack of transparency, other nations also track space objects, and some private companies maintain commercially available catalogues.

Rather than this patchwork of incomplete sources, what the world needs is a unified system of space traffic management. Through this, spacefaring nations and companies could agree to share more of their tracking data and cooperate to make space safer. This might require the creation of a new global regime, such as an international convention, through which rules and technical standards could be organized. One analogy is the International Telecommunication Union, the United Nations agency that coordinates global telecommunications issues such as who can transmit in which parts of the radio spectrum.

It won’t be easy to create such a system for space traffic. For it to succeed, questions of safety (such as avoiding smashing up a satellite) will need to be disentangled from questions of security (such as whether that satellite is spying on another nation) so that countries can be assured that participating in such an effort would not compromise national security. Countries could, for instance, share information about the location of a satellite without sharing details of its capabilities or purpose for being in space.

One near-term move that would help would be for the United States to complete a planned shift of responsibility for the Space-Track.org catalogue from the military to the civilian Department of Commerce. Because this catalogue has historically been the most widely used around the world, shifting it to a civilian agency could start to defuse geopolitical tensions and so improve global efforts to manage space debris. It might one day feed into a global space-traffic agreement between nations; even the nascent space superpower China would have a big incentive to participate, despite rivalries with the United States. The transition was called for in a 2018 US presidential directive that recognizes that companies are taking over from national governments as the dominant players in space, but it has yet to occur, in part because Congress has not allocated the necessary funds.

On 25 August, the UN Committee on the Peaceful Uses of Outer Space will meet to discuss a range of topics related to international cooperation in space. The UN is the right forum through which spacefaring nations can work together to establish norms for responsible space behaviour, and that should include how the world can track objects to make space safer. It should continue recent work it has been doing emphasizing space as a secure and sustainable environment, which at least brings countries such as the United States and China into the same conversation.

Basic research has a role, too: innovations such as techniques to track and display the locations of orbiting objects in real time, and artificial intelligence to help automate debris-avoidance manoeuvres, could bolster any global effort to monitor and regulate space.

If governments and companies around the world do not take urgent action to work together to make space safer, they will one day face a catastrophic collision that knocks out one or more satellites key to their safety, economic well-being or both. Space is a global commons and a global resource. A global organization responsible for — and capable of — managing the flow of space traffic is long overdue.

## 1NC – DA

#### Democracy’s on the brink – control of information will determine its fate

Nye 18 [(Joseph, Distinguished Visiting Fellow at the Hoover Institution, University Distinguished Service Professor Emeritus and former dean of Harvard’s Kennedy School of Government, PhD in political science from Harvard) “Protecting Democracy in an Era of Cyber Information War,” Hoover Institution, 11/13/2018] JL

Today, in the face of successful Chinese control of what citizens can see and say on the Internet and Russian use of the Internet to interfere in the 2016 American election, the United States (and allied democracies) find themselves on the defensive. The expected asymmetries seem to have been reversed. Autocracies are able to protect themselves by controlling information flows, while the openness of democracies creates vulnerabilities that autocracies can exploit via information warfare. Ironically, one cause of the vulnerabilities has been the rise of social media and mobile devices in which American companies have been the global leaders. Citizens voluntarily carry Big Brother and his relatives in their pockets. Along with big data and artificial intelligence, technology has made the problem of defending democracy from information warfare far more complicated than foreseen two decades ago. And while rule of law, trust, truth, and openness make democracies asymmetrically vulnerable, they are also critical values to defend. Any policy to defend against cyber information war must start with the Hippocratic oath: first, do no harm.

The use of information as an instrument of conflict and manipulation in international politics has a long history. Britain manipulated information to move American opinion in the direction of war with Germany both in 1917 and 1941. The United States and the Soviet Union both used broadcasts, covert organizations, and funds to interfere in foreign elections during the Cold War.3 And more narrowly, in battlefield situations in Iraq or in the campaign against ISIS, information was an important tool. In recent years, Russia’s hybrid war against Ukraine has encompassed both cyber attacks and manipulation of information. Information operations are a critical component of modern warfare.4

Russia has used propaganda to express preferences for candidates in American elections since at least 1964, but new technologies have amplified their impact enormously.5 According to former CIA Director Michael Hayden, Russian interference in the 2016 election was “the most successful covert influence campaign in recorded history.”6 For example, Russian operatives used Facebook to publicize 129 staged events, drawing attention of 340,000 users; 10 million people saw ads paid for by Russian accounts; and 126 million Americans saw posts by 470 accounts affiliated with the Russian Internet Research Agency.7 A study by Twitter reported that 50,000 Russia-linked accounts were automated and tweeted election related content.8 Reports released by the Senate Intelligence Committee estimate that the Russian campaign reached not only the 126 million people on Facebook but another 20 million more on Instagram.9 Some Russian messages were crafted to support particular candidates while others were designed to create a general sense of chaos. Still others were micro-targeted to suppress voting by particular demographic groups such as African-Americans or younger voters. While skeptics argue that Russian efforts were a small percentage of the total content on the Internet, “for sub-groups of targeted Americans, the messaging was perhaps ubiquitous.”10

Before the Internet, such operations involved costly training and movement of spies across borders, establishment of foreign bank accounts, and transfers of cash. Now similar effects can be accomplished remotely at much lower cost. It is much easier to send electrons across borders than human agents. Ransoming a failed spy can be costly, but if no one clicks on a phishing e mail, it is simple, deniable, and virtually free to send another. In 1983, when the KGB seeded the rumor that AIDS was the product of U.S. government experiments with biological weapons, the rumor started with an anonymous letter to a small New Delhi newspaper and then was propagated globally but slowly over several years by widespread reproduction and constant repetition in conventional media. It took four years to reach full fruition. 11 In 2016, an updated version of the same technique was used to create “Pizzagate,” the bizarre rumor that Hillary Clinton’s campaign manager ran a child sex ring in a Washington restaurant. It spread instantly on the Internet. What’s new is not the basic model; it’s the speed with which such disinformation can spread and the low cost of spreading it.

With its armies of paid trolls and botnets, along with outlets such as Russia Today (RT) and Sputnik, Russian intelligence, after hacking into the e-mails of the Democratic National Committee and senior Clinton campaign officials, could distract and disrupt news cycles week after week without setting foot in the United States. And it could also count on the witting and unwitting help of organizations like Wikileaks. Russian messages aimed at priming, framing, agenda setting, and contagion were accelerated by U.S. media that were too quick and unreflective in using the Russian phrasing and frames.12 American voters are subject to many influences, and there were many potential causes of the narrow outcome of the 2016 election. It is far too simple just to blame manipulation of social media. As social scientists say, the outcome was “overdetermined.” But whatever its effects on the particular election outcome, Russia was able to accomplish its deeper goal of sowing disruption and discrediting the democratic model. It successfully undercut American soft power.

#### Constellations are key to democracy promotion – they put authoritarian leaders on the defensive – it’s perceptual and proven by opposition to satellites

Schwille 4/12 [(Michael, senior policy analyst at RAND, research interest focuses on the integration of information into combined arms warfare, M.A. in international development studies from George Washington University) “Satellite Internet Services—Fostering the Dictator's Dilemma?” RAND Corporation, 4/12/2021] JL

Constellations of low-altitude, low-latency satellites providing broadband internet access to wide swathes of the earth are an impending challenge to the information dominance enjoyed by the world's authoritarian states. Whether Amazon's proposed Project Kuiper, Elon Musk's Starlink (already functional in some areas of North America), or the United Kingdom funded OneWeb, the ability to provide relatively low cost internet access outside of government control is both a challenge for authoritarian states and an opportunity for democracies.

In Russia, the Duma is already considering a law to criminalize access to such satellite services. China is not only planning to launch a competing service, it has Starlink's Musk concerned about having his satellites “blown up.” North Korea, which bans its citizens from accessing the internet and (in)famously attacks leaflets with machine guns, shells loudspeakers with artillery, and punishes citizens for accessing Chinese cellphone towers, has yet to comment publicly on such services. Given this history though, Pyongyang's reaction is unlikely to be very positive.

What are low-altitude, low-latency satellites and why are authoritarian states so concerned? The problem (for authoritarians) and promise (for democracies) are the services' ability to provide broadband internet access almost anywhere on earth, with nothing new required on the ground aside from a small terminal. Because these satellites orbit at several hundred kilometers (low Earth orbit), versus 35,000km for telecommunication satellites in geostationary orbit, their terminals can be smaller, portable, and easier to conceal, smuggle, and infiltrate. With one of these terminals, users can cheaply and quickly bypass national controls on the internet and information access, plus place phone (e.g. Voice over Internet Protocol, Skype, or Zoom) calls outside of government-controlled systems. It is this freedom of information access and communication that has Russia and China so concerned, and that provides an opportunity for democratic states to rebalance their current information disadvantage.

In what some scholars have termed democracy's dilemma, nations that rely on relatively free and open information flows are vulnerable to having that openness turned against them by adversaries. Think Russian influence on Brexit, the 2016 U.S. elections and the COVID-19 infodemic. What these new satellite systems offer is an opportunity to reinvigorate the dictator's dilemma (PDF)—the fear authoritarian leaders have of nonregime narratives reaching their people, or their people communicating outside of government-approved channels.

Just how powerful is this fear? Moscow reacts more negatively to criticisms and threats to its information control than it does to (far more expensive) NATO exercises. For years, Russian state media have even coordinated to deflect these criticisms of Russia's censorship onto countries with which Moscow is in conflict, successively targeting Georgia, the United States, and Ukraine.

China's rulers have a similar view, more fearful of “American ideals of freedom, democracy, and human rights infecting the people of China and Hong Kong,” than they are of U.S. military or economic challenges. This is not a new concern for Beijing; the term *Great Firewall of China* was discussed in a Wired article back in 1997. Beijing's controls have expanded since, with hundreds of thousands of censors and billions of dollars spent on informational and societal control, including the uniquely intrusive social credit systems (PDF).

North Korea is an even clearer example, with years of North Korea specialists (see Lankov, Baek, Cha, Myers, and others) highlighting Pyongyang's reliance on domestic information control to keep the Kim family in power. Impressive control, but a weakness masquerading as a strength.

This desire for information control represents both the dictator's dilemma and democracy's opportunity. Beijing, Moscow, and Pyongyang (as well as Tehran and others) are clearly concerned about the threat posed by unsupervised information access. Washington (or Brussels, London, Tokyo…whomever) publicly advocating for more open internet access, coupled with a clear mention of the new satellite services, would quickly command attention and establish a compelling narrative (and underlying threat). Coupling this message with a reminder of the West's ability to challenge information controls by, for example, smuggling bulky typewriters, printing presses, and Xerox machines into Eastern Europe in the 80s, which increased the flow of uncensored information, would add credibility to the threat—if authoritarian states thought typewriters were a problem, infiltrating an “internet in a box” (or thousands of them) looms as an even more compelling danger. The physical threat of infiltrated devices combined with a narrative advocating freedom of information access provide the West with a new, information-based tool for foreign policy leverage. A tool, or active measure, based not on fear, deception, or disinformation, but simply on information access.

By offering an information-based response to an information-based attack, this tool offers a fresh, calibrated response option. Chinese cyber espionage or recent attacks on Hong Kong's civil liberties, Russian attempts to influence Brexit or U.S. elections (or the more recent SolarWinds hack), North Korean attacks on Sony or South Korea's ATM network, are all activities ripe for response. Once this tool is effectively demonstrated in terms of fostering the dictator's dilemma, democracy's response and deterrence toolkits, for both cyber and influence activities, commensurately expands.

Importantly, the utility of this information tool is not confined simply to allowing outside information in; it also allows information to flow out (especially important with North Korea). Perhaps most importantly, it provides another tool to avoid government monitoring inside an authoritarian state. When paired with mesh networks of the type used, for example, during demonstrations in Hong Kong, it further increases the opportunity for the free flow of information dictators perceive as so threatening.

This tool (or its threatened use) does not replace other foreign policy tools—diplomatic, economic, and military tools remain options; this proposal simply adds a new information-based capability. The tool fits within a historical context of Western information activities and offers a compelling public narrative—fighting censorship. The hardware costs are relatively low, largely borne by the companies launching the satellites, and coming into existence whether governments wish them to or not. Finally, by rebalancing democracy's dilemma through a reinforcement of the dictator's dilemma, this tool offers an information response to information/cyber/influence attacks, using a method that clearly targets the vulnerabilities and sensitivities of authoritarian adversaries.

#### Democracy is key to US primacy – independently, democratic peace solves war

Kendall-Taylor 16 [(Andrea, a deputy national intelligence officer for Russia and Eurasia at the National Intelligence Council and a nonresident senior associate in the Human Rights Initiative at the Center for Strategic and International Studies in Washington, D.C.) Center for Strategic and International Studies, 7/15/2016] BC

Although the number of democracies in the world is at an all-time high, there are a number of key trends that are working to undermine democracy. The rollback of democracy in a few influential states or even in a number of less consequential ones would almost certainly accelerate meaningful changes in today’s global order.

Democratic decline would weaken U.S. partnerships and erode an important foundation for U.S. cooperation abroad. Research demonstrates that domestic politics are a key determinant of the international behavior of states. In particular, democracies are more likely to form alliances and cooperate more fully with other democracies than with autocracies. Similarly, authoritarian countries have established mechanisms for cooperation and sharing of “worst practices.” An increase in authoritarian countries, then, would provide a broader platform for coordination that could enable these countries to overcome their divergent histories, values, and interests—factors that are frequently cited as obstacles to the formation of a cohesive challenge to the U.S.-led international system.

Recent examples support the empirical data. Democratic backsliding in Hungary and the hardening of Egypt’s autocracy under Abdel Fattah el-Sisi have led to enhanced relations between these countries and Russia. Likewise, democratic decline in Bangladesh has led Sheikh Hasina Wazed and her ruling Awami League to seek closer relations with China and Russia, in part to mitigate Western pressure and bolster the regime’s domestic standing.

Although none of these burgeoning relationships has developed into a highly unified partnership, democratic backsliding in these countries has provided a basis for cooperation where it did not previously exist. And while the United States certainly finds common cause with authoritarian partners on specific issues, the depth and reliability of such cooperation is limited. Consequently, further democratic decline could seriously compromise the United States’ ability to form the kinds of deep partnerships that will be required to confront today’s increasingly complex challenges. Global issues such as climate change, migration, and violent extremism demand the coordination and cooperation that democratic backsliding would put in peril. Put simply, the United States is a less effective and influential actor if it loses its ability to rely on its partnerships with other democratic nations.

A slide toward authoritarianism could also challenge the current global order by diluting U.S. influence in critical international institutions, including the United Nations , the World Bank, and the International Monetary Fund (IMF). Democratic decline would weaken Western efforts within these institutions to advance issues such as Internet freedom and the responsibility to protect. In the case of Internet governance, for example, Western democracies support an open, largely private, global Internet. Autocracies, in contrast, promote state control over the Internet, including laws and other mechanisms that facilitate their ability to censor and persecute dissidents. Already many autocracies, including Belarus, China, Iran, and Zimbabwe, have coalesced in the “Likeminded Group of Developing Countries” within the United Nations to advocate their interests.

Within the IMF and World Bank, autocracies—along with other developing nations—seek to water down conditionality or the reforms that lenders require in exchange for financial support. If successful, diminished conditionality would enfeeble an important incentive for governance reforms. In a more extreme scenario, the rising influence of autocracies could enable these countries to bypass the IMF and World Bank all together. For example, the Chinese-created Asian Infrastructure and Investment Bank and the BRICS Bank—which includes Russia, China, and an increasingly authoritarian South Africa—provide countries with the potential to bypass existing global financial institutions when it suits their interests. Authoritarian-led alternatives pose the risk that global economic governance will become fragmented and less effective.

Violence and instability would also likely increase if more democracies give way to autocracy. International relations literature tells us that democracies are less likely to fight wars against other democracies, suggesting that interstate wars would rise as the number of democracies declines. Moreover, within countries that are already autocratic, additional movement away from democracy, or an “authoritarian hardening,” would increase global instability. Highly repressive autocracies are the most likely to experience state failure, as was the case in the Central African Republic, Libya, Somalia, Syria, and Yemen. In this way, democratic decline would significantly strain the international order because rising levels of instability would exceed the West’s ability to respond to the tremendous costs of peacekeeping, humanitarian assistance, and refugee flows.

Finally, widespread democratic decline would contribute to rising anti-U.S. sentiment that could fuel a global order that is increasingly antagonistic to the United States and its values. Most autocracies are highly suspicious of U.S. intentions and view the creation of an external enemy as an effective means for boosting their own public support. Russian president Vladimir Putin, Venezuelan president Nicolas Maduro, and Bolivian president Evo Morales regularly accuse the United States of fomenting instability and supporting regime change. This vilification of the United States is a convenient way of distracting their publics from regime shortcomings and fostering public support for strongman tactics.

#### US leadership in this decade solves global war and results in a peaceful end to Chinese revisionism **Erickson and Collins 10/21** [(Andrew, A professor of strategy in the U.S. Naval War College’s China Maritime Studies Institute)(Gabriel, Baker Botts fellow in energy and environmental regulatory affairs at Rice University’s Baker Institute for Public Policy) “A Dangerous Decade of Chinese Power Is Here,” Foreign Policy, 10/18/2021] **U.S. and allied policymakers are facing the most important foreign-policy challenge of the 21st century. China’s power is peaking; so is the political position of Chinese President Xi Jinping and the Chinese Communist Party’s (CCP) domestic strength. In the long term, China’s likely decline after this peak is a good thing. But right now, it creates a decade of danger from a system that increasingly realizes it only has a short time to fulfill some of its most critical, long-held goals.**

Within the next five years, China’s leaders are likely to conclude that its deteriorating demographic profile, structural economic problems, and technological estrangement from global innovation centers are eroding its leverage to annex Taiwan and achieve other major strategic objectives. As Xi internalizes these challenges, his foreign policy is likely to become even more accepting of risk, feeding on his nearly decadelong track record of successful revisionist action against the rules-based order. Notable examples include China occupying and militarizing sub-tidal features in the South China Sea, ramping up air and maritime incursions against Japan and Taiwan, pushing border challenges against India, occupying Bhutanese and Tibetan lands, perpetrating crimes against humanity in [Xinjiang](https://www.nytimes.com/interactive/2019/11/16/world/asia/china-xinjiang-documents.html), and coercively enveloping Hong Kong.

The relatively low-hanging fruit is plucked, but Beijing is emboldened to grasp the biggest single revisionist prize: Taiwan.

Beijing’s actions over the last decade have triggered backlash, such as with the so-called AUKUS deal, but concrete constraints on China’s strategic freedom of action may not fully manifest until after 2030. It’s remarkable and dangerous that China has paid few costs for its actions over the last 10 years, even as its military capacities have rapidly grown.

Beijing will likely conclude that under current diplomatic, economic, and force postures for both “gray zone” and high-end scenarios, the 2021 to late 2020s timeframe still favors China—and is attractive for its 68-year-old leader, who seeks a historical achievement at the zenith of his career.

U.S. planners must mobilize resources, effort, and risk acceptance to maximize power and thereby deter Chinese aggression in the coming decade—literally starting now—and innovatively employ assets that currently exist or can be operationally assembled and scaled within the next several years. That will be the first step to pushing back against China during the 2020s—a decade of danger—before what will likely be a waning of Chinese power.

As Beijing aggressively seeks to undermine the international order and promotes a narrative of inevitable Chinese strategic domination in Asia and beyond, it creates a dangerous contradiction between its goals and its medium-term capacity to achieve them. China is, in fact, likely nearing the apogee of its relative power; and by 2030 to 2035, it will cross a tipping point from which it may never recover strategically. Growing headwinds constraining Chinese growth, while not publicly acknowledged by Beijing, help explain Xi’s high and apparently increasing risk tolerance. Beijing’s window of strategic opportunity is sliding shut.

China’s skyrocketing household debt levels exemplify structural economic constraints that are emerging much earlier than they did for the United States when it had similar per capita GDP and income levels. Debt is often a wet blanket on consumption growth. A 2017 analysis published by the Bank for International Settlements found that once the household debt-to-GDP ratio in a sample of 54 countries exceeded 60 percent, “the negative long-run effects on consumption tend to intensify.” China’s household debt-to-GDP ratio surpassed that empirical danger threshold in late 2020. Rising debt service burdens thus threaten Chinese consumers’ capacity to sustain the domestic consumption-focused “dual circulation” economic model that Xi and his advisors seek to build. China’s growth record during the past 30 years has been remarkable, but past exceptionalism does not confer future immunity from fundamental demographic and economic headwinds.

As debt levels continue to rise at an absolute level that has accelerated almost continuously for the past decade, China also faces a hollowing out of its working-age population. This critical segment peaked in 2010 and has since declined, with the rate from 2015 to 2020 nearing 0.6 percent annually—nearly twice the respective pace in the United States. While the United States faces demographic challenges of its own, the disparity between the respective paces of decline highlights its relative advantage compared to its chief geopolitical competitor. Moreover, the United States can choose to access a global demographic and talent dividend via immigration in a way China simply will not be able to do.

Atop surging debt and worsening demographics, China also faces resource insecurity. China’s dependence on imported food and energy has grown steadily over the past two decades. Projections from Tsinghua University make a compelling case that China’s oil and gas imports will peak between 2030 and 2035. As China grapples with power shortages, Beijing has been reminded that supply shortfalls equal to even a few percentage points of total demand can have outsized negative impacts.

Domestic resource insufficiency by itself does not hinder economic growth—as the Four Asian Tigers’ multi-decade boom attests. But China is in a different position. Japan and South Korea never had to worry about the U.S. Navy interdicting inbound tankers or grain ships. In fact, the United States was avowedly willing to use military force to protect energy flows from the Persian Gulf region to its allies. Now, as an increasingly energy-secure United States pivots away from the Middle East toward the Indo-Pacific, there is a substantial probability that energy shipping route protection could be viewed in much more differentiated terms—with oil and liquefied natural gas cargoes sailing under the Chinese flag viewed very differently than cargoes headed to buyers in other regional countries.

Each of these dynamics—demographic downshifts, rising debts, resource supply insecurity—either imminently threatens or is already actively interfering with the CCP’s long-cherished goal of achieving a “moderately prosperous society.” Electricity blackouts, real estate sector travails (like those of Evergrande) that show just how many Chinese investors’ financial eggs now sit in an unstable $52 trillion basket, and a solidifying alignment of countries abroad concerned by aggressive Chinese behavior all raise questions about Xi’s ability to deliver. With this confluence of adverse events only a year before the next party congress, where personal ambition and survival imperatives will almost drive him to seek anointment as the only Chinese “leader for life” aside from former leader Mao Zedong, the timing only fuels his sense of insecurity. Xi’s anti-corruption campaigns and ruthless removal of potential rivals and their supporters solidified his power but likely also created a quiet corps of opponents who may prove willing to move against him if events create the perception he’s lost the “mandate of heaven.” Accordingly, the baseline assumption should be that Xi’s crown sits heavy and the insecurity induced is thereby intense enough to drive high-stake, high-consequence posturing and action.

While Xi is under pressure to act, the external risks are magnified because so far, he has suffered few consequences from taking actions on issues his predecessors would likely never have gambled on. Reactions to party predations in Xinjiang and [Hong Kong](https://home.treasury.gov/policy-issues/financial-sanctions/recent-actions/20210716_33) have been restricted to diplomatic-signaling pinpricks, such as sanctioning responsible Chinese officials and entities, most of whom lack substantial economic ties to the United States. Whether U.S. restraint results from a fear of losing market access or a belief that China’s goals are ultimately limited is not clear at this time.

While the CCP issues retaliatory sanctions against U.S. officials and proclaims a triumphant outcome to its hostage diplomacy, these tactical public actions mask a growing private awareness that China’s latitude for irredentist action is poised to shrink. Not knowing exactly when domestic and external constraints will come to bite—but knowing that when Beijing sees the tipping point in its rearview mirror, major rivals will recognize it too—amplifies Xi and the party’s anxiety to act on a shorter timeline. Hence the dramatic acceleration of the last few years.

Just as China is mustering its own strategic actions, so the United States must also intensify its focus and deployment of resources. The United States has taken too long to warm up and confront the central challenge, but it retains formidable advantages, agility, and the ability to prevail—provided it goes all-in now. Conversely, if Washington fails to marshal its forces promptly, its achievements after 2030 or 2035 will matter little. Seizing the 2020s would enable Beijing to ~~cripple~~ [destroy] the free and open rules-based order and entrench its position by economically subjugating regional neighbors (including key U.S. treaty allies) to a degree that could offset the strategic headwinds China now increasingly grapples with.

Deterrence is never certain. But it offers the highest probability of avoiding the certainty that an Indo-Pacific region dominated by a CCP-led China would doom treaty allies, threaten the U.S. homeland, and likely set the stage for worse to come. Accordingly, U.S. planners should immediately mobilize resources and effort as well as accept greater risks to deter Chinese action over the critical next decade.

The greatest threat is armed conflict over Taiwan, where U.S. and allied success or failure will be fundamental and reverberate for the remainder of the century. There is a high chance of a major move against Taiwan by the late 2020s—following an extraordinary ramp-up in People’s Liberation Army capabilities and before Xi or the party state’s power grasp has ebbed or Washington and its allies have fully regrouped and rallied to the challenge.

So how should policymakers assess the potential risk of Chinese action against Taiwan reaching dangerous levels by 2027 or possibly even earlier—as emphasized in the testimonies of Adms. Philip Davidson and John Aquilino? In June, Chairman of the Joint Chiefs Gen. Mark Milley testified to the House of Representatives that Xi had “challenged the People’s Liberation Army to accelerate their modernization programs to develop capabilities to seize Taiwan and move it from 2035 to 2027,” although China does not currently have the capabilities or intentions to conduct an all-out invasion of mainland Taiwan.

U.S. military leaders’ assessments are informed by some of the world’s most extensive and sophisticated internal information. But what’s striking is open-source information available to everyone suggests similar things. Moving forward, a number of open-source indicators offer valuable “early warning lights” that can help policymakers more accurately calibrate both potential timetables and risk readings as the riskiest period of relations—from 2027 onward—approaches.

Semiconductors supply self-sufficiency. Taiwan is the “OPEC+” of semiconductors, accounting for approximately two-thirds of global chip foundry capacity. A kinetic crisis would almost certainly disrupt—and potentially even completely curtail—semiconductor supplies. China presently spends even more each year on semiconductor imports (around $380 billion) than it does on [oil](http://english.customs.gov.cn/Statics/0aba4bfd-f8ed-477c-9d16-dc3def897b7b.html), but much of the final products are destined for markets abroad. Taiwan is producing cutting-edge 5-nanometer and 7-nanometer chips, but China produces around 80 percent of the rest of the chips in the world. The closer China comes to being able to secure “good enough” chips for “inside China-only” needs, the less of a constraint this becomes.

Crude oil, grain, strategic metals stockpiles—the commercial community (Planet Labs, Ursa Space Systems, etc.) has developed substantial expertise in cost-effectively tracking inventory changes for key input commodities needed to prepare for war.

Electric vehicle fleet size—the amount of oil demand displaced by electric vehicles varies depending on miles driven, but the more of China’s car fleet that can be connected to the grid (and thus powered by blockade-resistant coal), the less political burden Beijing will face if it has to weather a maritime oil blockade imposed in response to actions it took against Taiwan or other major revisionist adventures. China’s passenger vehicle fleet, now approximately 225 million units strong, counts nearly 6.5 million electric vehicles among its ranks, the lion’s share of which are full-battery electrics. China’s State Council seeks to have 20 percent of new vehicles sold in China be electric vehicles by 2025. This target has already basically been achieved over the last few months, meaning at least 3.5 to 4 million (and eventually many more) new elective vehicles will enter China’s car fleet each year from now on.

Local concentration of maritime vessels—snap exercises with warships, circumnavigations, and midline tests with swarms of aircraft highlight the growing scale of China’s threat to [Taiwan](https://www.andrewerickson.com/2021/06/quick-look-cmsis-4-6-may-2021-conference-large-scale-amphibious-warfare-in-chinese-military-strategy-taiwan-strait-campaign-focus/). But these assets alone cannot invade the island. To capture and garrison, Beijing would need not only air, missile, naval, and special operations forces but also the ability to move lots of equipment and—at the very least—tens of thousands of personnel across the Taiwan Strait. As such, Beijing would have to amass maritime transport assets. And given the scale required, this would alter ship patterns elsewhere along China’s coast in ways detectable with artificial intelligence-facilitated imagery analysis from firms like Planet Labs (or national assets).

Only the most formidable, agile American and allied deterrence can kick the can down the road long enough for China’s slowdown to shut the window of vulnerability. Holding the line is likely to require frequent and sustained proactive enforcement actions to disincentivize full-frontal Chinese assaults on the rules-based order in the Indo-Pacific. Chinese probing behavior and provocations must be met with a range of symmetric and asymmetric responses that impose real costs, such as publishing assets owned by Chinese officials abroad, cyber interference with China’s technological social control apparatus, “hands on” U.S. Navy and Coast Guard enforcement measures against Maritime Militia-affiliated vessels in the South China Sea, intensified air and maritime surveillance of Chinese naval bases, and visas and resettlement options to Hong Kongers, Uyghurs, and other threatened Chinese citizens—including CCP officials (and their families) who seek to defect and/or leave China. U.S. policymakers must make crystal clear to their Chinese counterparts that the engagement-above-all policies that dominated much of the past 25 years are over and the risks and costs of ongoing—and future—adventurism will fall heaviest on China.

Bombastic Chinese reactions to emerging cohesive actions verify the approach’s effectiveness and potential for halting—and perhaps even reversing—the revisionist tide China has unleashed across the Asian region. Consider the recent nuclear submarine deal among Australia, the United States, and the United Kingdom. Beijing’s strong public reaction (including toleration of [nuclear threats](https://www.globaltimes.cn/page/202109/1234460.shtml) made by the state-affiliated *Global Times*) highlights the gap between its global information war touting China’s irresistible power and deeply insecure internal self-perception. Eight nuclear submarines will ultimately represent formidable military capacity, but for a bona fide superpower that believes in its own capabilities, they would not be a game-changer. Consider the U.S.-NATO reaction to the Soviet Union’s commissioning of eight Oscar I/II-class cruise missile subs during the late Cold War. These formidable boats each carried 24 SS-N-19 Granit missiles specifically designed to kill U.S. carrier battle groups, yet NATO never stooped to public threats.

With diplomatic proofs of concepts like the so-called AUKUS deal, the Quadrilateral Security Dialogue, and hard security actions like the Pacific Deterrence Initiative now falling into place, it is time to comprehensively peak the non-authoritarian world’s protective action to hold the line in the Indo-Pacific. During this decade, U.S. policymakers must understand that under Xi’s strongman rule, personal political survival will dictate Chinese behavior. Xi’s recreation of a “one-man” system is a one-way, high-leverage bet that decisions he drives will succeed.

If Xi miscalculates, a significant risk given his suppression of dissenting voices while China raises the stakes in its confrontation with the United States, the proverbial “leverage” that would have left him with outsized returns on a successful bet would instead amplify the downside, all of which he personally and exclusively signed for. Resulting tensions could very realistically undermine his status and authority, embolden internal challengers, and weaken the party. They could also foreseeably drive him to double down on mistakes, especially if those led to—or were made in the course of—a kinetic conflict. Personal survival measures could thus rapidly transmute into regional or even global threats.

If Xi triggered a “margin call” on his personal political account through a failed high-stakes gamble, it would likely be paid in blood. Washington must thus prepare the U.S. electorate and its institutional and physical infrastructure as well as that of allies and partners abroad for the likelihood that tensions will periodically ratchet up to uncomfortable levels—and that actual conflict is a concrete possibility. Si vis pacem, para bellum (“if you want peace, prepare for war”) must unfortunately serve as a central organizing principle for a variety of U.S. and allied decisions during the next decade with China.

Given these unforgiving dynamics and stakes, implications for U.S. planners are stark: Do whatever remains possible to “peak” for deterrent competition against China by the mid-to-late 2020s, and accept whatever trade-offs are available for doing so.

Nothing we might theoretically achieve in 2035 and beyond is worth pursuing at the expense of China-credible capabilities we can realistically achieve no later than the mid-to-late 2020s.

## 1NC – Case

### 1NC – Debris

#### Debris creates deterrence by raising the bar for conflict – international norms fail

Miller 7/31 [(Gregory, Chair of the Department of Space Power at the Air Command and Staff College, Ph.D. in Political Science from The Ohio State University) “Deterrence by Debris: The Downside to Cleaning up Space,” Space Policy, 7/31/2021] JL

The danger of kinetic strikes increasing orbital debris is a common theme in the literature, but the positive deterrent effects of some debris are often overlooked. The debris resulting from destroyed satellites, or other space objects, creates a deterrent effect on actors who might otherwise violate international norms and strike at objects in space, either to test their capabilities or as an act of hostilities. This is not deterrence in the traditional sense, of one actor publicly threatening punishment in response to another actor’s unwanted actions. It is not deterrence by denial since the attacker is not damaged and may even achieve its objective. Nor is it deterrence by punishment because the debris itself does not threaten to punish the attacker’s country. But debris can increase the future costs to the aggressor, even if their initial attack succeeds, and thus it has a similar restraining effect on certain behavior. Like the automated response of the U.S. tripwire in West Germany, the threat that debris can pose to state interests acts as a form of deterrence, at least to prevent some actors from taking certain types of actions. Removing the danger of debris will weaken that restraint and thus weaken deterrence, making ASAT tests and hostile actions in space more likely.

Several factors may deter a state from launching kinetic tests or striking against an adversary’s interests in space. For one thing, if a state’s adversary has similar capabilities to destroy objects in space, deterrence would be a function of not wanting to escalate tensions. Although international law only explicitly prohibits states from placing weapons of mass destruction in orbit, international space law, like the Outer Space Treaty [30], does provide a framework for addressing the activities of one state that lead to the damage of another state’s property. Likewise, there are international norms (informal but expected rules of behavior) against the weaponization of space. But these norms seem to be in decline [31], and such norms only deter a state from engaging in certain types of behavior if the state cares about following norms, if it cares about how states perceive its behavior, or if it believes other states are willing to enforce the norms. The beauty of debris as a deterrent is that it does not rely on the enforcement of norms or the credibility of states to succeed.

#### Space debris creates existential deterrence and a taboo

Bowen 18 [(Bleddyn, lecturer in International Relations at the University of Leicester) “The Art of Space Deterrence,” European Leadership Network, February 20, 2018, https://www.europeanleadershipnetwork.org/commentary/the-art-of-space-deterrence/] TDI

Fourth, the ubiquity of space infrastructure and the fragility of the space environment may create a degree of existential deterrence. As space is so useful to modern economies and military forces, a large-scale disruption of space infrastructure may be so intuitively escalatory to decision-makers that there may be a natural caution against a wholesale assault on a state’s entire space capabilities because the consequences of doing so approach the mentalities of total war, or nuclear responses if a society begins tearing itself apart because of the collapse of optimised energy grids and just-in-time supply chains. In addition, the problem of space debris and the political-legal hurdles to conducting debris clean-up operations mean that even a handful of explosive events in space can render a region of Earth orbit unusable for everyone. This could caution a country like China from excessive kinetic intercept missions because its own military and economy is increasingly reliant on outer space, but perhaps not a country like North Korea which does not rely on space. The usefulness, sensitivity, and fragility of space may have some existential deterrent effect. China’s catastrophic anti-satellite weapons test in 2007 is a valuable lesson for all on the potentially devastating effect of kinetic warfare in orbit.

#### No impact to debris – it hits stations all the time.

Cain ’15 (Fraser; 12/23/15; writer for Universe Today; “How Do Astronauts Avoid Debris”; http://www.universetoday.com/121067/how-do-astronauts-avoid-debris)

So, just how do we keep our space stations, ships and astronauts from being riddled with holes from all of the space junk in orbit around Earth? We revel in the terror grab bag of all the magical ways to get snuffed in space. Almost as much as we celebrate the giant brass backbones of the people who travel there. We’ve already talked about all the scary ways that astronauts can die in space. My personal recurring “Hail Mary full of grace, please don’t let me die in space” nightmare is orbital debris. We’re talking about a vast collection of spent rockets, dead satellites, flotsam, jetsam, lagan and derelict. It’s not a short list. NASA figures there are **21,000 bits of junk** bigger than 10 cm, **500,000 particles** between 1 and 10 cm, and more than **100 million** smaller than 1 cm. Sound familiar, humans? This is our high tech, sci fi great Pacific garbage patch. Sure, a tiny rivet or piece of scrap foil doesn’t sound very dangerous, but consider the fact that astronauts are orbiting the Earth at a velocity of about 28,000 km/h. And the Tang packets, uneaten dehydrated ice cream, and astronaut poops are also traveling at 28,000 km/h. Then think about what happens when they collide. Yikes… or yuck. Here’s the International Space Station’s solar array. See that tiny hole? Embiggen and clarinosticate! That’s a tiny puncture hole made in the array by a piece of orbital crap. The whole station is **pummeled by tiny pieces of space program junk drawer contents**. Back when the Space Shuttle was flying, NASA had to **constantly replace their windows because of the damage they were experiencing** from the orbital equivalent of Dennis the Menace hurling paint chips, fingernail clippings, and frozen scabs.

**Probability – 0.1% chance of a collision.**

**Salter 16** [(Alexander William, Economics Professor at Texas Tech) “SPACE DEBRIS: A LAW AND ECONOMICS ANALYSIS OF THE ORBITAL COMMONS” 19 STAN. TECH. L. REV. 221 \*numbers replaced with English words] TDI

The probability of a collision is currently low. Bradley and Wein estimate that the maximum probability in LEO of a collision over the lifetime of a spacecraft remains below one in one thousand, conditional on continued compliance with NASA’s deorbiting guidelines.3 However, the possibility of a future “snowballing” effect, whereby debris collides with other objects, further congesting orbit space, remains a significant concern.4 Levin and Carroll estimate the average immediate destruction of wealth created by a collision to be approximately $30 million, with an additional $200 million in damages to all currently existing space assets from the debris created by the initial collision.5 The expected value of destroyed wealth because of collisions, currently small because of the low probability of a collision, can quickly become significant if future collisions result in runaway debris growth.

**We should have passed tipping points and collisions inevitable – inserted 1AC Zenko**

A January 2007 direct ascent ASAT test carried out by China against its defunct Fengyun-1C weather satellite instantly increased the amount of space debris in low earth orbit (LEO) by 40 percent. Debris is especially problematic in LEO, where half of the world's 1,100 active satellites operate. Space objects—even flecks of paint—travel as fast as eighteen thousand miles per hour and can cause catastrophic damage to manned and unmanned spacecraft—creating even more debris in the process. The U.S. National Research Council estimates that portions of LEO have reached a "tipping point," with hundreds of thousands of space debris larger than one centimeter stuck in orbit that will collide with other pieces of debris or spacecraft,

**Time frame – Kessler effect 200 years away**

**Stubbe 17** [(Peter, PhD in law @ Johann Wolfgang Goethe University Frankfurt) “State Accountability for Space Debris: A Legal Study of Responsibility for Polluting the Space Environment and Liability for Damage Caused by Space Debris,” Koninklijke Brill Publishing, ISBN 978-90-04-31407-8, p. 27-31] TDI

The prediction of possible scenarios of the future evolution of the debris p o p ulation involves many uncertainties. Long-term forecasting means the prediction of the evolution of the future debris environment in time periods of decades or even centuries. Predictions are based on models84 that work with certain assumptions, and altering these parameters significantly influences the outcomes of the predictions. Assumptions on the future space traffic and on the initial object environment are particularly critical to the results of modeling efforts.85 A well-known pattern for the evolution of the debris population is the so-called Kessler effect’, which assumes that there is a certain collision probability among space objects because many satellites operate in similar orbital regions. These collisions create fragments, and thus additional objects in the respective orbits, which in turn enhances the risk of further collisions. Consequently, the num ber of objects and collisions increases exponentially and eventually results in the formation of a self-sustaining debris belt aroundthe Earth. While it has long been assumed that such a process of collisional cascading is likely to occur only in a very long-term perspective (meaning a time 1 n of several hundred years),87 a consensus has evolved in recent years that an uncontrolled growth of the debris population in certain altitudes could become reality much sooner.88 In fact, a recent cooperative study undertaken by various space agencies in the scope of i a d c shows that the current l e o debris population is unstable, even if current mitigation measures are applied. The study concludes:

Even with a 90% implementation of the commonly-adopted mitigation measures [...] the l e o debris population is expected to increase by an average of 30% in the next 200 years. The population growth is primarily driven by catastrophic collisions between 700 and 1000 km altitudes and such collisions are likely to occur every 5 to 9 years.89

#### Use or lose is wrong – It’d be irrational AND never be contemplated by any state.

Kroenig 18 Matthew Kroenig, Associate Professor in the Department of Government and the Edmund A. Walsh School of Foreign Service at Georgetown, The Logic of American Nuclear Strategy: Why Strategic Superiority Matters, Oxford UPress, pp. 137-142

The second, and more common, argument as to why nuclear superiority might be destabilizing is because the state in the position of nuclear inferiority (in this case, America’s adversaries) may feel “use ’em or lose ’em” (UELE) pressures, but this argument also withers under interrogation.26

According to strategic stability theorists, a US nuclear advantage increases the danger of nuclear war because the inferior opponent may fear that its nuclear arsenal is vulnerable to a first strike. Rather, than wait for the adversary (in this case the United States) to move first and wipe out, or seriously blunt, its strategic forces, the argument goes, the inferior state may decide to intentionally launch a nuclear war early in a crisis in order to avoid suffering a disarming first strike. This is the logic most often invoked by strategic stability theorists when they claim that US nuclear advantages are destabilizing. This is also the precise problem identified and inspired by Wohlstetter’s basing studies.

Use ’em or lose ’em enjoys a certain superficial plausibility, but, upon closer inspection, there are two fundamental reasons why the logic simply does not hold up. First, it ignores the fact that the superior state retains a healthy ability to retaliate. So, even if the inferior state is worried about having its nuclear weapons eliminated in a first strike, the decision to launch its nuclear weapons first as a coping mechanism would be a decision to intentionally launch a nuclear war against a state with at least a secure, second-strike capability. This means that even if the inferior state launches its nuclear weapons first, it will be virtually guaranteed to suffer devastating nuclear retaliation. Moreover, given that it is in a situation of extreme inferiority (so extreme that it might even be vulnerable to a preemptive nuclear strike), this would mean intentionally launching a devastating nuclear war that will likely turn out much worse for itself then for its opponent. It would simply be irrational for a state to intentionally launch a nuclear war against a state with an assured retaliatory capability.

Let us consider a concrete example. The United States maintains nuclear superiority over China, as we have seen in previous chapters. Strategic stability theorists want us to believe that if the United States takes additional steps to further enhance its superiority, then China would face even greater temptations to launch a nuclear first strike against the US homeland in the event of a serious crisis. In other words, strategic stability theorists hold that China would be so worried about losing a devastating nuclear war against United States that it would intentionally choose to start a devastating nuclear war against the United States. The argument does not make sense.

### 1NC – Collisions

#### No impact---collisions have already happened, radioactive material will stay in space, and it’s higher than most objects in orbit.

Rebecca Harrington 16. Senior News Editor who works across INSIDER and Business Insider, 3/10/16, “Dozens of dead nuclear reactors are floating in space, and they'll eventually hit the earth,” https://www.businessinsider.com/nuclear-powered-satellites-space-2016-3

Radioactive materials, like uranium-235, can power a tiny satellite for years. They're more reliable than batteries and provide more energy than solar panels. But back then, space-faring nations weren't as concerned with radioactive waste. Nuclear disasters like Three Mile Island and Chernobyl hadn't happened yet, and now we're much more worried about radiation exposure. That's why the last nuclear-powered satellite, launched by the Soviet Union, blasted into orbit in 1988. More than 30 different nuclear-reactor-powered satellites still orbit the earth. The US launched only one while the USSR launched all the rest. Those nuclear reactors are similar to the ones in nuclear power plants on the ground. Uranium-235 undergoes fission, where its nucleus splits, giving off energy. This energy can be converted into electricity to power satellite instruments, or your house. America's uranium-fueled SNAP-10A entered into an orbit of 575 miles above the earth in 1965. It operated for 43 days before it stopped responding. It's now in a slow trajectory to hit the ground in about 3,000 years. By then, hopefully, its radioactive cargo will be mostly harmless. But if any of these nuclear-reactor-powered satellites collide with another object in space, or suddenly crash to the ground, they could release radioactivity. The Soviet Union had a few such mishaps since it launched all those nuclear satellites. In 1978, its spy satellite, Kosmos 954, crashed into the Northwest Territories, scattering radioactivity across almost 48,000 square miles. The USSR had to pay Canada $10 million for the damage. And in 1995, NASA scientists found a cloud of liquid, radioactive sodium and potassium coolant in orbit. The space agency eventually figured out that it came from the Soviet satellite Kosmos 1900. Something else in space crashed into it, causing the nuclear reactor to leak. The cloud of radioactive fluids is still floating up there, and space agencies continue to monitor it. The good news is that all of these dead nuclear-reactor-powered satellites are in orbits higher than 430 miles. There's barely any air molecules at that height to slow down the satellites, so it should take them hundreds or thousands of years to wind their way back to the earth — at which point much of their radioactive contents will have significantly decayed.

No UQ about nuclear powered space

### 1NC – Asteroids

#### No warrant for cognitive bias – applies to all xrisks because they seem large and far away

#### Their Fish evidence doesn’t say detection is sufficient to avoid strikes

#### Detection alone is inadequate and current deflection methods fail – only private innovation solves

Hasco 5/4 [(Linda, reporter at Penn Live) “NASA simulation confirms there’s no technology able to stop a massive asteroid from hitting,” Penn Live, 5/4/2021] JL

Simulations carried out by leading space agencies have concluded. There currently is no technology available that could stop a massive asteroid from “wiping out” Europe.

A report by Independent said that NASA conducted the week-long exercise, which concluded from the hypothetical impact scenario, that even with a six-month advance notice, current capabilities could not prevent a catastrophe.

Participants in the simulation, which was conducted during a planetary defense conference hosted by the United Nations, said the only course of action on such short notice would be evacuation of an area before an asteroid hit. However, the simulation’s impact zone covered large parts of North Africa and Europe.

Reportedly, the hypothetical impact exercise revealed that governments are dreadfully unprepared for this type of disaster.

Lindley Johnson, Nasa’s Planetary Defense Officer noted that this kind of exercise helps reveal who the “key players are in a disaster event, and who needs to know what information and when,” the report cited.

Johnson added that the exercises help with communication among the planetary defense community and their governments to ensure a coordinated effort in the event of a future potential impact threat.

The news of the simulation’s failure evoked a response from SpaceX boss Elon Musk, who said the current inadequate capability to deal with an impact threat was “one of many reasons why we need larger and more advanced rockets.”

SpaceX recently secured a $2.89 billion contract with NASA to develop its next-generation Starship spacecraft. SpaceX claims that Starship, when combined with its Super Heavy rocket Booster, will be “the world’s most powerful launch vehicle ever developed,” and could “theoretically” assist in missions designed to redirect the path of an Earth-bound asteroid.

NASA is working on asteroid deflection technology which will attempt to change the orbit of an asteroid and hopefully give credence that such a strategy could be effective at mitigating the threat of dangerous near-Earth objects in the future.

#### If 1AC Brownfield is correct, that proves detection alone is inadequate because it’s already on a collision course

#### No chance of apocalyptic NEOs. Consensus of studies.

Mark Boslough, Earth and Planetary Sciences @ University of New Mexico, PhD in applied physics from CalTech '19, Uncertainty and Risk at the Catastrophe Threshold, in Planetary Defense Global Collaboration for Defending Earth from Asteroids and Comets

There has been confusion over language used to describe risk reduction attributed to surveys. It is often said that risk is “retired” when an asteroid is discovered and is found to be in a benign orbit. However, risk is (by definition) a human assessment that includes uncertainty. Assessed risk is a redundant term, but the adjective reinforces this notion. When uncertainty is reduced through more observation or understanding, the assessed risk can change. The act of discovering an asteroid that is not on a collision course reduces the assessed risk. For a population of NEOs in unknown orbits, the risk is aleatory, because the trajectories can be thought of as random within some range. After they are discovered (and determined to be no threat), they can be “retired” or removed from the random population for purposes of risk assessment. The assessed risk is reduced, but the intrinsic (previously unknown) probability of impact is unchanged. An asteroid is either on a collision course or it isn’t, regardless of whether or not it has a name and entry in the Minor Planet Center database. A rational policy and course of action can only be based on our current risk assessment, which incorporates all we know. If our knowledge changes because something is discovered to be on a collision course, we can reduce its contribution to the risk by deflecting it.

NEO surveys have greatly succeeded in contributing to risk reduction because our assessment of impact probability has decreased. The 90% goal has been exceeded, and discovery of smaller objects continues to accelerate. The assessed risk of a global impact apocalypse has been virtually eliminated in our time. The likelihood of a continental-scale catastrophe has been greatly diminished, and the overall risk (measured in average fatalities per year) has been cut by an order of magnitude to a round-number estimate of about 100. More recent assessments (Boslough et al. 2015b; Mathias et al. 2017; Reinhardt et al. 2016; Rumpf et al. 2017; Stokes et al. 2017) make use of large-scale computer simulations and include the Earth’s population distribution with better estimates of asteroid populations and physical effects over a wide range of energies and asteroid physical properties. They remain in broad agreement with one another.

**We know where asteroids are. None could hit earth.**

Al **Globus 14**, worked on the asteroid mining, space settlement, Hubble, ISS, X37, Earth observation, TDRSS, cubesats, lunar teleoperation, spaceflight affects on bone, computational fluid dynamics visualization, molecular nanotechnology and space solar power, board member of the National Space Society, June 6, “Understanding the Asteroid Threat,” Rooster GNN, http://en.roostergnn.com/2014/06/06/understanding-the-asteroid-threat/128689/

What is the current probability of an asteroid striking Earth? Depends on the size. Little ones hit every day. A city killer once or twice a century. Extinction event about **every 100 million years** (it’s been 66 million years). These, of course, are averages. We could get an extinction event tomorrow — or not for 200 million years. Fortunately, **we know where almost all of the big asteroids** (extinction event) that could hit Earth are and **none of them will hit us for at least 100 years**. We don’t know where 90% of the somewhat smaller asteroids are — ones that could devastate a region (say, the Eastern seaboard). We only know the location of 1% of the city killers. Even better, if we detect an incoming asteroid in time **we could deflect it.** Thus, if we were to mount a vigorous detection campaign we could make the probability essentially zero. This would cost around 1% of our civil space program budget.

### 1NC – Ozone

#### Ozone layer is increasing – flips U/Q.

Horton 21 Helena Horton 9-15-2021 "‘Larger than usual’: this year’s ozone layer hole bigger than Antarctica" <https://www.theguardian.com/environment/2021/sep/16/larger-than-usual-ozone-layer-hole-bigger-than-antarctica> (Environmental Journalist for the Guardian)//Elmer

The hole in the ozone layer that develops annually is “rather larger than usual” and is currently bigger than Antartica, say the scientists responsible for monitoring it. Researchers from the Copernicus Atmosphere Monitoring Service say that this year’s hole is growing quickly and is larger than 75% of ozone holes at this stage in the season since 1979. Ozone exists about seven to 25 miles (11-40km) above the Earth’s surface, in the stratosphere, and acts like a sunscreen for the planet, shielding it from ultraviolet radiation. Every year, a hole forms during the late winter of thesouthern hemisphere as the sun causes ozone-depleting reactions, which involve chemically active forms of chlorine and bromine derived from human-made compounds. In a statement Copernicus said that this year’s hole “has evolved into a rather larger than usual one”. Vincent-Henri Peuch, the service’s director, told the Guardian: “We cannot really say at this stage how the ozone hole will evolve. However, the hole of this year is remarkably similar to the one of 2020, which was among the deepest and the longest-lasting – it closed around Christmas – in our records since 1979.

#### Alt causes – inserted 1AC Voosen in green

But 2 years ago, researchers found evidence that in Earth's worst extinction—the end-Permian, 252 million years ago—volcanoes lofted Siberian salt deposits into the stratosphere, where they might have fed chemical reactions that obliterated the ozone layer and sterilized whole forests. Now, spores from the end-Devonian make a compelling case that, even without eruptions, a warming climate can deplete the ozone layer

#### Two thumpers to Ozone:

#### Space Tourism

Marais 21 Eloise Marais 7-19-2021 "Space tourism: rockets emit 100 times more CO₂ per passenger than flights – imagine a whole industry" <https://theconversation.com/space-tourism-rockets-emit-100-times-more-co-per-passenger-than-flights-imagine-a-whole-industry-164601> (Associate Professor in Physical Geography, UCL)//Elmer

The commercial race to get tourists to space is heating up between Virgin Group founder Sir Richard Branson and former Amazon CEO Jeff Bezos. On Sunday 11 July, Branson ascended 80 km to reach the edge of space in his piloted Virgin Galactic VSS Unity spaceplane. Bezos’ autonomous Blue Origin rocket is due to launch on July 20, coinciding with the anniversary of the Apollo 11 Moon landing. Though Bezos loses to Branson in time, he is set to reach higher altitudes (about 120 km). The launch will demonstrate his offering to very wealthy tourists: the opportunity to truly reach outer space. Both tour packages will provide passengers with a brief ten-minute frolic in zero gravity and glimpses of Earth from space. Not to be outdone, Elon Musk’s SpaceX will provide four to five days of orbital travel with its Crew Dragon capsule later in 2021. What are the environmental consequences of a space tourism industry likely to be? Bezos boasts his Blue Origin rockets are greener than Branson’s VSS Unity. The Blue Engine 3 (BE-3) will launch Bezos, his brother and two guests into space using liquid hydrogen and liquid oxygen propellants. VSS Unity used a hybrid propellant comprised of a solid carbon-based fuel, hydroxyl-terminated polybutadiene (HTPB), and a liquid oxidant, nitrous oxide (laughing gas). The SpaceX Falcon series of reusable rockets will propel the Crew Dragon into orbit using liquid kerosene and liquid oxygen. Burning these propellants provides the energy needed to launch rockets into space while also generating greenhouse gases and air pollutants. Large quantities of water vapour are produced by burning the BE-3 propellant, while combustion of both the VSS Unity and Falcon fuels produces CO₂, soot and some water vapour. The nitrogen-based oxidant used by VSS Unity also generates nitrogen oxides, compounds that contribute to air pollution closer to Earth. Roughly two-thirds of the propellant exhaust is released into the stratosphere (12 km-50 km) and mesosphere (50 km-85 km), where it can persist for at least two to three years. The very high temperatures during launch and re-entry (when the protective heat shields of the returning crafts burn up) also convert stable nitrogen in the air into reactive nitrogen oxides. These gases and particles have many negative effects on the atmosphere. In the stratosphere, nitrogen oxides and chemicals formed from the breakdown of water vapour convert ozone into oxygen, depleting the ozone layer which guards life on Earth against harmful UV radiation. Water vapour also produces stratospheric clouds that provide a surface for this reaction to occur at a faster pace than it otherwise would. Space tourism and climate change Exhaust emissions of CO₂ and soot trap heat in the atmosphere, contributing to global warming. Cooling of the atmosphere can also occur, as clouds formed from the emitted water vapour reflect incoming sunlight back to space. A depleted ozone layer would also absorb less incoming sunlight, and so heat the stratosphere less. Figuring out the overall effect of rocket launches on

the atmosphere will require detailed modelling, in order to account for these complex processes and the persistence of these pollutants in the upper atmosphere. Equally important is a clear understanding of how the space tourism industry will develop. Virgin Galactic anticipates it will offer 400 spaceflights each year to the privileged few who can afford them. Blue Origin and SpaceX have yet to announce their plans. But globally, rocket launches wouldn’t need to increase by much from the current 100 or so performed each year to induce harmful effects that are competitive with other sources, like ozone-depleting chlorofluorocarbons (CFCs), and CO₂ from aircraft. During launch, rockets can emit between four and ten times more nitrogen oxides than Drax, the largest thermal power plant in the UK, over the same period. CO₂ emissions for the four or so tourists on a space flight will be between 50 and 100 times more than the one to three tonnes per passenger on a long-haul flight. In order for international regulators to keep up with this nascent industry and control its pollution properly, scientists need a better understanding of the effect these billionaire astronauts will have on our planet’s atmosphere.

#### No Ozone Impact.

Ridley 14 (Matthew White Ridley, BA and PhD in Zoology from Oxford. “THE OZONE HOLE WAS EXAGGERATED AS A PROBLEM,” *Rational Optimist*, 9/25/14, <http://www.rationaloptimist.com/blog/the-ozone-hole-was-exaggerated-as-a-problem.aspx>) dwc 19

Serial hyperbole does the environmental movement no favours My recent Times column 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 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 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 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.