## 1

### T

#### Interpretation – the affirmative must defend the whole resolution

#### ‘The’ means all parts.

Merriam-Websters 8 Online Collegiate Dictionary, http://www.m-w.com/cgi-bin/dictionary

4 -- used as a function word before a noun or a substantivized adjective to indicate reference to a group as a whole <the elite>

#### Means the noun must be interpreted generically

Webster’s 9 (Merriam-Webster’s Online Dictionary, “The”, http://www.merriam-webster.com/dictionary/the)

3 a—used as a function word before a singular noun to indicate that the noun is to be understood generically <the dog is a domestic animal> b—used as a function word before a singular substantivized adjective to indicate an abstract idea <an essay on the sublime>

#### Violation – The neg specifies a plan that is a portion of the resolution – they said in cross examination that they only defend a few companies

#### Standards –

#### Limits – A] Not defending the whole resolution gives them access to infinite plans that makes negating impossible since I can’t prep for everything and B] They justify not defending the resolution which over-limits their ground.

#### Educational engagement – It’s impossible for me to predict what they can read and I can’t answer their aff – I can’t even read a US PIC against them if they don’t defend the US which is a generic – It’s impossible to engage their affirmative which is bad for education.

#### Legal precision - We should focus on the specific definition of words in the resolution – words have precise meaning and if you don’t follow it it’s impossible to understand what they are saying – using exact definitions is key to participating in analyzing governmental positions and making changes in the real world which takes out the reason we are debating in the first place.

## 2

### CP

#### CP Text:

#### The United States should fund the mining of rare earth metals from asteroids by private entities

#### The United States should fund the development of O’Neill Cylinders

#### The United States should fund the development of debris removal technology

#### States should ban the appropriation of outer space by private entities omitting the United States

#### Internal Net-Benefit 1 – REM Gatekeeping

#### The PIC is key to beat China and protect against Chinese REM gatekeeping

Stavridis 21 [(James, retired US Navy admiral, chief international diplomacy and national security analyst for NBC News, senior fellow at JHU Applied Physics Library, PhD in Law and Diplomacy from Tufts) “U.S. Needs a Strong Defense Against China’s Rare-Earth Weapon,” Bloomberg Opinion, March 4, 2021, <https://www.bloomberg.com/opinion/articles/2021-03-04/u-s-needs-a-strong-defense-against-china-s-rare-earth-weapon>] TDI Re-Cut Ethan Yang

You could be forgiven if you are confused about what’s going on with rare-earth elements. On the one hand, news reports indicate that China may increase production quotas of the minerals this quarter as a [goodwill gesture](https://www.scmp.com/news/china/diplomacy/article/3122501/china-raises-rare-earth-quotas-goodwill-trade-signal-us) to the Joe Biden administration. But other sources say that China may ultimately ban the export of the rare earths altogether on “[security concerns](https://www.bloomberg.com/news/articles/2021-02-19/china-may-ban-rare-earth-technology-exports-on-security-concerns?sref=QYxyklwO).” What’s really going on here? There are 17 elements considered [rare earths](https://www.bloomberg.com/news/articles/2021-02-16/why-rare-earths-are-achilles-heal-for-europe-u-s-quicktake) — lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, scandium and yttrium — and while many aren’t actually rare in terms of global deposits, extracting them is difficult and expensive. They are used across high-tech manufacturing, including smartphones, fighter aircraft and components in virtually all advanced electronics. Of particular note, they are essential to many of the clean-energy technologies expected to come online in this decade. I began to focus on rare-earth elements when I commanded the North Atlantic Treaty Organization’s presence in Afghanistan, known as the International Security Assistance Force. While Afghans live in an extremely poor country, [studies](https://thediplomat.com/2020/02/afghanistans-mineral-resources-are-a-lost-opportunity-and-a-threat/) have assessed that they sit atop $1 trillion to $3 trillion in a wide variety of minerals, including rare earths. Some [estimates](https://www.fraserinstitute.org/article/afghanistans-rare-earth-element-bonanza) put the rare-earth levels alone at 1.4 million metric tons. But every time I tried to visit a mining facility, the answer I got from my security team was, “It’s too dangerous right now, admiral.” Unfortunately, despite a great deal of effort by the U.S. and NATO, those security challenges remain, deterring the large foreign-capital investments necessary to harvest the lodes. Which brings us back to Beijing. China controls roughly 80% of the rare-earths market, between what it mines itself and processes in raw material from elsewhere. If it decided to wield the weapon of restricting the supply — something it has repeatedly [threatened](https://www.wsj.com/articles/china-trade-fight-raises-specter-of-rare-earth-shortage-11559304000) to do — it would create a significant challenge for manufacturers and a geopolitical predicament for the industrialized world. It could happen. In 2010, Beijing threatened to cut off exports to Japan over the disputed Senkaku Islands. Two years ago, Beijing was reportedly considering restrictions on exports to the U.S. generally, as well as against specific companies (such as defense giant Lockheed Martin Corp.) that it deemed in violation of its policies against selling advanced weapons to Taiwan. President Donald Trump’s administration issued an executive order to spur the production of rare earths domestically, and created an [Energy Resource Governance Initiative](https://www.state.gov/wp-content/uploads/2019/06/Energy-Resource-Governance-Initiative-ERGI-Fact-Sheet.pdf) to promote international mining. The European Union and Japan, among others, are also aggressively seeking newer sources of rare earths. Given this tension, it was superficially surprising that China announced it would boost its mining quotas in the first quarter of 2021 by nearly 30%, reflecting a continuation in strong (and rising) demand. But the increase occurs under a shadow of uncertainty, as the Chinese Communist Party is undertaking a “review” of its policies concerning future sales of rare earths. In all probability, the tactics of the increase are temporary, and fit within a larger strategy. China will go to great lengths to maintain overall control of the global rare-earths supply. This fits neatly within the geo-economic approach of the [One Belt, One Road](https://www.bloomberg.com/opinion/articles/2019-10-30/china-is-determined-to-reshape-the-globe) initiative, which seeks to use a variety of carrots and sticks — economic, trade, diplomatic and security — to create zones of influence globally. In terms of rare earths, the strategy seems to be allowing carefully calibrated access to the elements at a level that makes it economically less attractive for competitors to undertake costly exploration and mining operations. This is similar to the oil-market strategy used by Russia and the Organization of Petroleum Exporting Countries for decades. Some free-market advocates believe that China will not take aggressive action choking off supply because that could [precipitate retaliation](https://www.bloomberg.com/opinion/articles/2021-02-22/china-weaponizing-rare-earths-technology-will-probably-backfire) or accelerate the search for alternate sources in global markets. What seems more likely is a series of targeted shutdowns directed against specific entities such as U.S. defense companies, Japanese consumer electronics makers, or European industrial concerns that have offended Beijing. The path to rare-earth independence for the U.S. must include: Ensuring supply chains of rare earths necessary for national security; promoting the exploitation of the elements domestically (and removing barriers to responsibly doing so); mandating that defense contractors and other critical-infrastructure entities wean themselves off Chinese rare earths; sponsoring research and development to find alternative materials, especially for clean energy technology; and creating a substantial stockpile of the elements in case of a Chinese boycott. This is a bipartisan agenda. The Trump administration’s [strategic assessment](https://www.commerce.gov/news/press-releases/2019/06/department-commerce-releases-report-critical-minerals) of what needs to be done (which goes beyond just 17 rare earths to include a total of 35 critical minerals) is thoughtful, and should serve as a basis for the Biden administration and Congress.

#### REM access key to military primacy and tech advancement – alts fail

Trigaux 12 (David, University Honors Program University of South Florida St. Petersburg) “The US, China and Rare Earth Metals: The Future Of Green Technology, Military Tech, and a Potential Achilles‟ Heel to American Hegemony,” USF St. Petersberg, May 2, 2012, <https://digital.stpetersburg.usf.edu/cgi/viewcontent.cgi?article=1132&context=honorstheses>] TDI Re-Cut Ethan Yang

The implications of a rare earth shortage aren’t strictly related to the environment, and energy dependence, but have distinct military implications as well that could threaten the position of the United States world’s strongest military. The United States place in the world was assured by powerful and decisive deployments in World War One and World War Two. Our military expansion was built upon a large, powerful industrial base that created more, better weapons of war for our soldiers. During the World Wars, a well-organized draft that sent millions of men into battle in a short amount of time proved decisive, but as the war ended, and soldiers drafted into service returned to civilian life, the U.S. technological superiority over its opponents provided it with sustained dominance over its enemies, even as the numerical size of the army declined. New technologies, such as the use of the airplane in combat, rocket launched missiles, radar systems, and later, GPS, precision guided missiles, missile defense systems, high tech tanks, lasers, and other technologies now make the difference between victory and defeat. The United States military now serves many important functions, deterring threats across the world. The United States projects its power internationally, through a network of bases and allied nations. Thus, the United States is a powerful player in all regions of the world, and often serves as a buffer against conflict in these regions. US military presence serves as a buffer against Chinese military modernization in Eastern Asia, against an increasingly nationalist Russia in Europe, and smaller regional actors, such as Venezuela in South America and Iran in the Middle East. The U.S. Navy is deployed all over the world, as the guarantor of international maritime trade routes. The US Navy leads action against challenges to its maritime sovereignty on the other side of the globe, such as current action against Somali piracy. Presence in regions across the world prevents escalation of potential crisis. These could result in either a larger power fighting a smaller nation or nations (Russia and Georgia, Taiwan and China), religious opponents (Israel and Iran), or traditional foes (Ethiopia and Eretria, Venezuela and Colombia, India and Pakistan). US projection is also key deterring emerging threats such as terrorism and nuclear proliferation. While not direct challenges to US primacy, both terrorism and nuclear proliferation can kill thousands. The US Air Force has a commanding lead over the rest of the world, in terms of both numbers and capabilities. American ground forces have few peers, and are unmatched in their ability to deploy to anywhere in the world at an equally unmatched pace. The only perceived challenge to the United States militarily comes from the People’s Republic of China.76 While the United States outspends all other nations in the world put together in terms of military spending, China follows as a close second, and has begun an extensive modernization program to boot.77 The Chinese military however, is several decades behind the United States in air power and nuclear capabilities.78 To compensate, China has begun the construction of access-denial technology, preventing the US from exercising its dominance in China’s sphere of influence.79 Chinese modernization efforts have a serious long-term advantage over the United States; access to rare earth metals, and a large concentration of rare earth chemists doing research.80 This advantage, coupled with the U.S. losing access to rare earth metals, will even the odds much quicker than policymakers had previously anticipated. 81 The largest example is US airpower. With every successive generation of military aircraft, the U.S. Air Force becomes more and more dependent on Rare Earth Metals.82 As planes get faster and faster, they have to get lighter and lighter, while adding weight from extra computers and other features on board.83 To lighten the weight of the plane, scandium is used to produce lightweight aluminum alloys for the body of the plane. Rare Earth metals are also useful in fighter jet engines, and fuel cells.84 For example, rare earths are required to producing miniaturized fins, and samarium is required to build the motors for the F-35 fighter jet.85 F-35 jets are the next generation fighter jet that works together to form the dual plane combination that cements U.S. dominance in air power over the Russian PAK FA.86 Rare earth shortages don’t just affect air power, also compromising the navigation system of Abrams Tanks, which need samarium cobalt magnets. The Abrams Tank is the primary offensive mechanized vehicle in the U.S. arsenal. The Aegis Spy 1 Radar also uses samarium.87 Many naval ships require neodymium. Hell Fire missiles, satellites, night vision goggles, avionics, and precision guided munitions all require rare earth metals. 88 American military superiority is based on technological advancement that outstrips the rest of the world. Command and control technology allows the U.S. to fight multiple wars at once and maintain readiness for other issues, as well as have overwhelming force against rising challengers. This technology helps the U.S. know who, where, and what is going to attack them, and respond effectively, regardless of the source of the threat. Rare Earth Elements make this technological superiority possible. To make matters worse, the defense industrial base is often a single market industry, dependent on government contracts for its business. If China tightens the export quotas further, major US defense contractors will be in trouble.89 Every sector of the defense industrial base is dependent on rare earth metals. Without rare earths, these contractors can’t build anything, which collapses the industry.90 Rare Earth shortages are actually already affecting our military, with shortages of lanthanum, cerium, europium and gadolinium happening in the status quo. This prevents us not only from building the next generation of high tech weaponry, but also from constructing more of the weapons and munitions that are needed in the status quo. As current weapon systems age and they can’t be replaced, the US primacy will be undermined. Of special concern is that U.S. domestic mining doesn’t produce “heavy” rare earth metals that are needed for many advanced components of military technologies. Given the nature of many military applications, substitutions aren’t possible. 91

#### Primacy and allied commitments solve arms races and great power war – unipolarity is sustainable, and prevents power vacuums and global escalation

Brands 18 [(Hal, Henry Kissinger Distinguished Professor at Johns Hopkins University's School of Advanced International Studies and a senior fellow at the Center for Strategic and Budgetary Assessments) "American Grand Strategy in the Age of Trump," Page 129-133] Re-Cut Ethan Yang

Since World War II, the United States has had a military second to none. Since the Cold War, America has committed to having overwhelming military primacy. The idea, as George W. Bush declared in 2002, that America must possess “strengths beyond challenge” has featured in every major U.S. strategy document for a quarter century; it has also been reflected in concrete terms.6 From the early 1990s, for example, the United States consistently accounted for around 35 to 45 percent of world defense spending and maintained peerless global power-projection capabilities.7 Perhaps more important, U.S. primacy was also unrivaled in key overseas strategic regions—Europe, East Asia, the Middle East. From thrashing Saddam Hussein’s million-man Iraqi military during Operation Desert Storm, to deploying—with impunity—two carrier strike groups off Taiwan during the China-Taiwan crisis of 1995– 96, Washington has been able to project military power superior to anything a regional rival could employ even on its own geopolitical doorstep. This military dominance has constituted the hard-power backbone of an ambitious global strategy. After the Cold War, U.S. policymakers committed to averting a return to the unstable multipolarity of earlier eras, and to perpetuating the more favorable unipolar order. They committed to building on the successes of the postwar era by further advancing liberal political values and an open international economy, and to suppressing international scourges such as rogue states, nuclear proliferation, and catastrophic terrorism. And because they recognized that military force remained the ultima ratio regum, they understood the centrality of military preponderance. Washington would need the military power necessary to underwrite worldwide alliance commitments. It would have to preserve substantial overmatch versus any potential great-power rival. It must be able to answer the sharpest challenges to the international system, such as Saddam’s invasion of Kuwait in 1990 or jihadist extremism after 9/11. Finally, because prevailing global norms generally reflect hard-power realities, America would need the superiority to assure that its own values remained ascendant. It was impolitic to say that U.S. strategy and the international order required “strengths beyond challenge,” but it was not at all inaccurate. American primacy, moreover, was eminently affordable. At the height of the Cold War, the United States spent over 12 percent of GDP on defense. Since the mid-1990s, the number has usually been between 3 and 4 percent.8 In a historically favorable international environment, Washington could enjoy primacy—and its geopolitical fruits—on the cheap. Yet U.S. strategy also heeded, at least until recently, the fact that there was a limit to how cheaply that primacy could be had. The American military did shrink significantly during the 1990s, but U.S. officials understood that if Washington cut back too far, its primacy would erode to a point where it ceased to deliver its geopolitical benefits. Alliances would lose credibility; the stability of key regions would be eroded; rivals would be emboldened; international crises would go unaddressed. American primacy was thus like a reasonably priced insurance policy. It required nontrivial expenditures, but protected against far costlier outcomes.9 Washington paid its insurance premiums for two decades after the Cold War. But more recently American primacy and strategic solvency have been imperiled. THE DARKENING HORIZON For most of the post–Cold War era, the international system was— by historical standards—remarkably benign. Dangers existed, and as the terrorist attacks of September 11, 2001, demonstrated, they could manifest with horrific effect. But for two decades after the Soviet collapse, the world was characterized by remarkably low levels of great-power competition, high levels of security in key theaters such as Europe and East Asia, and the comparative weakness of those “rogue” actors—Iran, Iraq, North Korea, al-Qaeda—who most aggressively challenged American power. During the 1990s, some observers even spoke of a “strategic pause,” the idea being that the end of the Cold War had afforded the United States a respite from normal levels of geopolitical danger and competition. Now, however, the strategic horizon is darkening, due to four factors. First, great-power military competition is back. The world’s two leading authoritarian powers—China and Russia—are seeking regional hegemony, contesting global norms such as nonaggression and freedom of navigation, and developing the military punch to underwrite these ambitions. Notwithstanding severe economic and demographic problems, Russia has conducted a major military modernization emphasizing nuclear weapons, high-end conventional capabilities, and rapid-deployment and special operations forces— and utilized many of these capabilities in conflicts in Ukraine and Syria.10 China, meanwhile, has carried out a buildup of historic proportions, with constant-dollar defense outlays rising from US$26 billion in 1995 to US$226 billion in 2016.11 Ominously, these expenditures have funded development of power-projection and antiaccess/area denial (A2/AD) tools necessary to threaten China’s neighbors and complicate U.S. intervention on their behalf. Washington has grown accustomed to having a generational military lead; Russian and Chinese modernization efforts are now creating a far more competitive environment.

#### Internal Net-Benefit 2 – O’Neill Cylinders

#### O’Neill Cylinders are on the way, but funding and companies like SpaceX and Blue Origin are key because governments are insufficient.

Kanchwalla 11-13-21

Hussain Kanchwalla (scholar at the Indian Institute of technology), 11-13-2021, "What is an O’Neill Cylinder?," Science ABC, https://www.scienceabc.com/nature/universe/what-is-oneill-cylinder.html, // HW AW

Many people believe that the Earth will soon be in danger and the sprawling nature of humanity is the undeniable cause. With the rapid [technological progress](https://www.scienceabc.com/nature/universe/what-is-kardashev-scale.html) and advancement of the past few centuries, we’re quickly exhausting the resources from planet Earth in order to power our industrial needs and global commerce. Many futurists feel that we will be left with no option but to explore and colonize space if we intend to survive into a future when resources on Earth can no longer meet our requirements. [Overpopulation is an imminent challenge](https://www.scienceabc.com/humans/malthusian-catastrophe-shortage-of-food-sources-population-explosion.html) that makes the need for interstellar travel and colonization even more urgent. That being said, [**building a space habitat**](https://www.scienceabc.com/nature/universe/can-we-build-a-habitable-planet-from-scratch.html) **is no easy pursuit and is loaded with daunting challenges, such as the need for construction facilities in space, the recreation of livable communities in space, the recycling and processing of waste, the simulation of artificial gravity, and most importantly—convincing governments and global organizations that this venture is worth pursuing.** The prospect of space colonization paves the way for devising methods to extract energy from resources on other planets. On Earth, harnessing energy from the Sun using [solar panels](https://www.scienceabc.com/innovation/why-is-there-a-limit-to-the-efficiency-of-solar-panels.html) isn’t particularly efficient, and faces inevitable barriers caused by the atmosphere and the daily occurrence of darkness (e.g., nighttime). However, in space, solar constructs can perpetually harness energy from the Sun without interruption. Utilizing this copious amount of energy would permit us to travel throughout our solar system without worrying about energy expenditure. Moreover, chemical resources would be in great supply in our solar system. To begin with, NASA has recently embarked on a project to generate fuel, water, and oxygen from resources present on the Moon. Given these foundations for why organizations should foray into developing a space habitat, allow me to introduce the **O’Neill cylinder—a space settlement design consisting of two counter-rotating cylinders** proposed by renowned physicist Gerard O’Neill a few decades ago. Aside from being a physicist, O’Neill was also a professor at Princeton University and a space enthusiast. Although he is most widely acclaimed for his work in physics, where he developed new concepts to explore particle physics at higher energies, his work on space colonization turned out to be his truly long-lasting legacy. Origin of the Idea for the O’Neill Cylinder While teaching physics to his students at Princeton University, O’Neill assigned them the task of designing a megastructure in space in order to demonstrate that living and surviving in space is actually a possibility. His students came up with numerous designs to accommodate human habitation in space. After a long session of brainstorming, O’Neill boiled their theories down to the idea of a cylinder-like space settlement design. Later, additional details and the functioning of this design were published in Physics Today in 1974; the cylinder was aptly called the O’Neill cylinder. Design of the O’Neill Cylinder The O’Neill cylinder design consists of two cylinders rotating in opposite directions on a [bearing](https://www.scienceabc.com/eyeopeners/what-is-a-bearing.html) to mitigate the gyroscopic effect. Each cylinder was proposed to be 20 miles long and 5 miles in diameter, with 6 broad stripes along its length (3 habitable spaces and 3 windows). O’Neill envisioned industrial processes and recreational facilities to be located on the central axis in a virtually zero-gravity environment. Gravity Simulation One key difference between living on Earth and living in space (or on any other astronomical body) is the difference in gravity. [Artificial gravity](https://www.scienceabc.com/innovation/can-create-artificial-gravity.html) is needed for stability, and the O’Neill cylinder has a provision to achieve exactly that. As the two giant cylinders rotate on their axis, they would leverage the centripetal force of any object in the inner surface to create artificial gravity. Considering the cylinder’s dimensions, the acceleration equation: a=v²/r, and substituting the acceleration value of Earth (i.e., 9.81), we can deduce that the cylinder would need to rotate roughly 28 times per hour to simulate an appropriate gravitational force. Earthly Environment Simulation Maintaining an atmosphere with a constitution similar to that of Earth is the next challenge when building a space habitation. The O’Neill cylinder is prudently designed with a ratio of gases similar to what is found on Earth. However, there is a caveat; the pressure is half of that at sea level. This would not impact our breathing substantially, but this minor trade-off would translate into a handful of benefits, such as bringing down the need for gas and the construction of thick walls. The proposed O’Neill cylinder also has provisions wherein the habitat would be able to control its own micro-climate using an arrangement of mirrors and by altering the ratio of gases in the cylinder. Day and Night Simulation With the human habitat situated in a vacuum (space), the cylinder essentially turns into a huge thermos! The theoretical O’Neill cylinder tried to overcome this issue by using a series of mirrors hinged on each of the three windows. This way, direct sunlight could be directed into the cylinder to simulate day time. Similarly, by turning the mirror away, a night-like ambience could be created. This simulated ‘night’ would also permit the heat produced biologically to radiate out of the cylinder. **Despite the design of the O’Neill cylinder being technically sound, the idea is too sophisticated to be implemented with our present technology**. Thus far, its implementation has been confined to the realm of science fiction. However, **given the efforts of organizations like SpaceX and Mars One, perhaps some day O’Neill cylinders will actually help humanity settle in the great vastness of space!**

#### **Permanently solves extinction**

Haynes 19, 5/17, Korey "O’Neill colonies: A decades-long dream for settling space," Astronomy, https://astronomy.com/news/2019/05/oneill-colonies-a-decades-long-dream-for-settling-space Top of Form

Bottom of Form

Last week, Amazon founder Jeff Bezos revealed his spaceship company’s new lunar lander, dubbed Blue Moon, and he spelled out a bold and broad vision for humanity’s future in space. Faced with the limits of resources here on Earth, most fundamentally energy, he pointed to life in space as a solution. “If we move out into the solar system, for all practical purposes, we have unlimited resources,” Bezos said. “We could have a trillion people out in the solar system.” And while colonies on other planets would be plagued by low gravity, long distances to Earth (leading to communication delays), and further limits down the road, those weaknesses are avoided if the colonies remain truly in space. To that end, Bezos instead suggested people consider taking up residence in O’Neill colonies, a futuristic concept for space settlements first dreamed up decades ago. “These are very large structures, miles on end, and they hold a million people or more each.” Gerard O’Neill was a physicist from Princeton University who teamed up with NASA in the 1970s on a series of workshops that explored efficient ways for humans to live off-world. Beyond influencing Bezos, his ideas have also deeply affected how many space experts and enthusiasts think about realistic ways of living in space. “What will space colonies be like?” O’Neill once asked the Space Science Institute he founded. “First of all, there’s no point in going out into space if the future that we see there is a sterile future of living in tin cans. We have to be able to recreate, in space, habitats which are as beautiful, as Earth-like, as the loveliest parts of planet Earth — and we can do that.” Of course, neither O’Neill nor anyone since has actually made such a habitat, but in many ways, the concepts he helped developed half a century ago remain some of the most practical options for large-scale and long-term space habitation. While NASA has mostly focused on exploring the moon and Mars in recent years, O’Neill colonies offer an option untethered to any planetary body. Instead, people would live in enormous circular structures in space that would be capable of hosting many thousands of people — or even millions according to Bezos — on a permanent basis. You may have seen these kinds of colonies in science fiction, from Star Trek, to the movie Interstellar. But in real life, researchers have thought up a a few variations: either a sphere, a cylinder, or a ring-shaped torus. All of these are designed to rotate and create a centrifugal force that mimics gravity for the inhabitants. While the sizes and specifications of the colonies vary, there are a few staples. In general, O’Neill colonies were designed to be permanent, self-sustaining structures. That means they would use solar power for electrical energy and for growing crops. The outer walls of an O’Neill colony are generally pictured as a transparent material, so that mirrors can aim sunlight through its walls as needed to provide light and energy – or to allow darkness, a feature humans also need, especially while we sleep. But building these colonies is a challenge beyond any humans have accomplished so far in space, and Bezos acknowledged that. He referred to two “gates” in his announcement, which he clarified as challenges that humans need to overcome. The first, which his company Blue Origin and other space entrepreneurs have been tackling, is to reduce the cost and difficulty of getting to space at all. But the second involves using resources from space, rather than hauling them from Earth. Bezos isn’t alone in such thinking. Most of NASA’s long-term plans for the Moon and Mars involve rely on harvesting materials and manufacturing products locally, using lunar and martian regolith to build and repair structures. And in the shorter term, three of the dozen experiments NASA selected as the first to fly as part of the new lunar program — possibly even by the end of the year — are what NASA terms “resource prospecting instruments.” That pairs well with O’Neill’s vision. These colonies are meant to use resources gathered from space, whether asteroids, the Moon, or even Mars. Doing so avoids the costly effort of heaving materials and goods out of Earth’s deep gravity well. That means they would be built using materials available cheaply in space. The humans and their attendant plants and animals would need to be carried from Earth. But raw materials like oxygen, nitrogen and aluminum are plentiful in the solar system, and mining for resources in space is a common theme across space settlement discussions. Because of their size, the colonies should be able to act as fully independent ecosystems, with plants to cycle air and water and resource cycles not so dissimilar from Earth. Humans are a long way from being able to launch anything like an O’Neill colony in the near future. But it’s somewhat telling that, after 50 years

#### Internal Net-Benefit 3 – Debris

#### Private entities key to debris management

Moore 21 [Moore, Adrian. “It's Time For US To Get Serious About Cleaning Up Space Junk,”.” TheHill. July 27, 2021. Web. December 13, 2021. <https://thehill.com/opinion/technology/564945- its-time-for-us-to-get-serious-about-cleaning-up-space-junk>.] Recut Ethan Yang

Orbital debris management is not well organized within the government. Right now, the Department of Defense (DOD) does most tracking of space debris for the U.S. out of the need to protect military satellites and national security interests. NASA has its own less advanced systems for tracking debris. However, orbital debris management is not just about tracking debris anymore. It is also about forming collision warning systems and safely managing traffic in space. To do this efficiently, we need a civil repository for all orbital debris components, something that many commercial space companies have already created on their own to stay aware of orbital debris and help protect their satellites in space. Tracking debris may be a national security priority, but providing space traffic control is not really in the Defense Department’s mission. We should be utilizing the private sector’s expertise and advancements in this area. For example, Astroscale has contracts with both the Japanese and European space agencies to develop orbital debris removal capability. And responsibility for developing collision warnings and space traffic management would be best suited for the Office of Space Commerce, an office with existing connections to the commercial space industry, NASA and DOD. Partnering with the debris tracking and removal systems private companies are developing while freeing up DOD to focus on military awareness and NASA to focus on research and development would be the most efficient way forward. If government works with private industry through strategic public-private partnerships, the U.S. can best address the threats posed by orbital debris and create sustainable policies for safe space exploration.

## 3

### DA

#### Mega-Constellations generates next-level weather forecasting.

Erwin 20 Sandra Erwin 10-14-2020 "SpaceX to explore ways to provide weather data to U.S. military" <https://spacenews.com/spacex-to-explore-ways-to-provide-weather-data-to-u-s-military/> (Sandra Erwin writes about military space programs, policy, technology and the industry that supports this sector. She has covered the military, the Pentagon, Congress and the defense industry for nearly two decades as editor of NDIA’s National Defense Magazine and Pentagon correspondent for Real Clear Defense.)//Elmer

The $2 million contract is to “assess the feasibility and long term viability of a ‘weather data as a service business model.” WASHINGTON — SpaceX is looking at ways it could provide weather data to the U.S. military. The company is working under a $2 million six-month study contract from the U.S. Space Force’s Space and Missile Systems Center. Charlotte Gerhart, chief of the Space and Missile Systems Center Production Corps Low Earth Orbit Division, said in a statement to SpaceNews that SpaceX received the contract in July from SMC’s Space Enterprise Consortium. The contract is to “assess the feasibility and long term viability of a ‘weather data as a service business model,’” said Gerhart. SpaceX did not respond to questions from SpaceNews on how the company would leverage the Starlink internet constellation to provide weather data. The contract awarded to SpaceX is part of a Space Force program called Electro Optical/Infrared Weather System (EO/IR EWS). The consortium in June awarded $309 million in contracts to Raytheon Technologies, General Atomics Electromagnetic Systems, and Atmospheric & Space Technology Research Associates to develop weather satellite prototypes and payloads. SpaceX won the portion of the EO/IR EWS program that is looking at how weather data could be purchased as a service from a commercial company. “The EWS program goal remains to provide a more resilient and higher refresh capability, enhancing global terrestrial weather capability,” said Gerhart. The SpEC consortium was created in 2017 to attract commercial space businesses to work with the military. The contracts awarded by SpEC are known as “other transaction authority” deals that are used for research projects and prototyping. The consortium on Oct. 8 informed its members that SpaceX had won the weather study contract. “The Air Force is pursuing a space-based environmental monitoring EO/IR system in a multi phased approach,” the SpEC said in an email to members. The EO/IR EWS program is looking at a future proliferated low-Earth orbit constellation to focus on cloud characterization and theater weather imagery that could be supplemented by commercial services. SpaceX’s contract is for the “weather data as a service system architecture exploration phase,” said SpEC. Industry sources speculated that SpaceX could provide weather data collected by sensors hosted on its own Starlink satellites, or it could team with a weather data services company and use Starlink to distribute the data to customers. One executive noted that both the U.S. military and the National Oceanic and Atmospheric Administration have growing demands for data that can be provided at relatively low cost from companies that operate proliferated LEO systems.

#### Solves climate change.

Taylor-Smith 21 Kerry Taylor-Smith 3-25-2021 "What Role can Advanced Weather Forecasting have in Providing Climate Crisis Solutions?" <https://www.azocleantech.com/article.aspx?ArticleID=1193> (Pursuing a passion for science, Kerry completed a degree in Natural Sciences at the University of Bath; where she studied a range of topics, including chemistry, biology, and environmental sciences. Her passion for writing grew as she worked on the university newspaper as a contributor, feature editor, and editor.)//Elmer

Humankind is in the midst of a climate crisis, battling to prevent global temperatures from rising while also keeping up with the energy demands of a growing population. Weather-related disasters cost billions of dollars each year, but it is not just the financial cost that should be considered – there is the loss of life, homes, wildlife, and infrastructure. There are several ways weather monitoring can help solve the climate crisis, from lowing transportation emissions to pinpointing extreme weather events such as wildfires and extraordinary variations in temperature. Tackling Emissions Global travel and shipping contribute significantly to global warming. Aircraft, ships, cars – nearly all modes of transportation emit harmful greenhouse gases, notably carbon dioxide, but also nitrous and sulfur oxides as well as particulates. These greenhouse gases trap heat in the Earth’s atmosphere, causing an overall warming effect and a negative impact on our climate. Aviation accounts for 2.4% of all anthropogenic carbon dioxide emissions, with international flights in 2019 producing 915 million tons of the gas. Weather forecasting technology providing accurate, real-time data on meteorological conditions can help airlines adjust routes to avoid headwinds or take advantage of favorable winds, both of which can help reduce fuel consumption and emissions. Shipping is one of the most fuel-efficient means of transport, but also one of the most polluting, contributing 3% of all greenhouse gas emissions - a figure expected to almost double by 2050. “Burning bunker fuel accounts for almost 90% of global sulfur emissions and the 15 largest ships in the world produce more sulfur each year than all cars put together,” states Renny Vandewege, Vice President of Weather Operations at DTN, a company providing decision support tools and forecast insights across many sectors. Shipping discharges a large and growing source of noxious gas but the sector has the potential to drastically cut emissions through fuel-saving techniques. Among the most promising is weather routing. “Using weather information and analytics can help mitigate risks today caused by climate change and can also reduce emissions further reducing future impacts”, explains Vandewege, a former director of the Broadcast Meteorology Program at Mississippi State University. Weather analytics can optimize routes and “reduce emissions up to 4% and reduce fuel consumption up to 10%

, depending on the type of vessel, the season, and the conditions,” states Vandewege. “If there’s bad weather ahead, sophisticated algorithms that use information about the ship and its capabilities and the weather effects on that specific ship can make numerous calculations and provide optimal route alternatives for the mariner.” Extreme Weather Events Advanced weather forecasting alerts us to the probability of extreme meteorological events occurring. While these events are largely unpredictable, accurate meteorological data can identify hotspots where they are likely to occur. The better the data, the better prepared the general public and authorities can be. Wildfires have ravaged the US state of California and huge swathes of land in Australia. Climate change is responsible for the increasing intensity and occurrence of blazes, not just here, but worldwide. It has created the optimal conditions for wildfires to start, including warmer weather, less precipitation, dryer vegetation, and stronger winds. Advanced weather forecasting, such as DTN’s live Geographic Information System (GIS) can monitor atmospheric conditions to evaluate wildfire risk and predict areas where conditions are just right for a wildfire to ignite. “Fire weather forecasting uses atmospheric conditions to evaluate wildfire risk,” explains Vendewege. “Meteorologists can also use their tools and experience to identify the specific location of wildfires. Sophisticated imaging systems can show fire locations in real time, allowing for a live look at the conditions using a GIS layer service containing the latest fire hotspot data and also showing the likelihood of a fire.” Machine learning, a means of artificial intelligence, can also be used in conjunction with current forecasting methods to predicts heat waves or cold snaps. These extreme weather events are the result of unusual atmospheric patterns that researchers from Rice University realized could be taught to a pattern recognition program. The technology, designed to work with current analog forecasting systems rather than replace them, could predict events with 80% accuracy, five days before the event occurred. Although only proof-of-concept, the technology could provide an early warning about when and where an extreme weather event might occur. Conclusion Humans are heavily reliant on the weather; it has a role in every aspect of our lives, from feeding us to providing power for our ever-growing needs. Climate change has warmed the planet and altered our weather, making extreme weather events such as droughts and floods more likely. High-tech weather forecasting technology can help in the fight against climate change by monitoring meteorological conditions to aid decision making, whether that be in the aviation or shipping industry, or by helping us understand and predict natural hazards and disasters, allowing us to reduce the risk of adverse events – and the costs, environmental, economic or otherwise.

#### Climate change causes extinction.

Dr. Peter Kareiva 18 – Ph.D. in Ecology and Applied Mathematics from Cornell University, Director of the Institute of the Environment and Sustainability at UCLA, Pritzker Distinguished Professor in Environment & Sustainability at UCLA, et al., September 2018, “Existential Risk Due To Ecosystem Collapse: Nature Strikes Back”, Futures, Volume 102, p. 39-50

In summary, six of the nine proposed planetary boundaries (phosphorous, nitrogen, biodiversity, land use, atmospheric aerosol loading, and chemical pollution) are unlikely to be associated with existential risks. They all correspond to a degraded environment, but in our assessment do not represent existential risks. However, the three remaining boundaries (climate change, global freshwater cycle, and ocean acidification) do pose existential risks. This is because of intrinsic positive feedback loops, substantial lag times between system change and experiencing the consequences of that change, and the fact these different boundaries interact with one another in ways that yield surprises. In addition, climate, freshwater, and ocean acidification are all directly connected to the provision of food and water, and shortages of food and water can create conflict and social unrest.

Climate change has a long history of disrupting civilizations and sometimes precipitating the collapse of cultures or mass emigrations (McMichael, 2017). For example, the 12th century drought in the North American Southwest is held responsible for the collapse of the Anasazi pueblo culture. More recently, the infamous potato famine of 1846–1849 and the large migration of Irish to the U.S. can be traced to a combination of factors, one of which was climate. Specifically, 1846 was an unusually warm and moist year in Ireland, providing the climatic conditions favorable to the fungus that caused the potato blight. As is so often the case, poor government had a role as well—as the British government forbade the import of grains from outside Britain (imports that could have helped to redress the ravaged potato yields).

Climate change intersects with freshwater resources because it is expected to exacerbate drought and water scarcity, as well as flooding. Climate change can even impair water quality because it is associated with heavy rains that overwhelm sewage treatment facilities, or because it results in higher concentrations of pollutants in groundwater as a result of enhanced evaporation and reduced groundwater recharge. Ample clean water is not a luxury—it is essential for human survival. Consequently, cities, regions and nations that lack clean freshwater are vulnerable to social disruption and disease.

Finally, ocean acidification is linked to climate change because it is driven by CO2 emissions just as global warming is. With close to 20% of the world’s protein coming from oceans (FAO, 2016), the potential for severe impacts due to acidification is obvious. Less obvious, but perhaps more insidious, is the interaction between climate change and the loss of oyster and coral reefs due to acidification. Acidification is known to interfere with oyster reef building and coral reefs. Climate change also increases storm frequency and severity. Coral reefs and oyster reefs provide protection from storm surge because they reduce wave energy (Spalding et al., 2014). If these reefs are lost due to acidification at the same time as storms become more severe and sea level rises, coastal communities will be exposed to unprecedented storm surge—and may be ravaged by recurrent storms.

A key feature of the risk associated with climate change is that mean annual temperature and mean annual rainfall are not the variables of interest. Rather it is extreme episodic events that place nations and entire regions of the world at risk. These extreme events are by definition “rare” (once every hundred years), and changes in their likelihood are challenging to detect because of their rarity, but are exactly the manifestations of climate change that we must get better at anticipating (Diffenbaugh et al., 2017). Society will have a hard time responding to shorter intervals between rare extreme events because in the lifespan of an individual human, a person might experience as few as two or three extreme events. How likely is it that you would notice a change in the interval between events that are separated by decades, especially given that the interval is not regular but varies stochastically? A concrete example of this dilemma can be found in the past and expected future changes in storm-related flooding of New York City. The highly disruptive flooding of New York City associated with Hurricane Sandy represented a flood height that occurred once every 500 years in the 18th century, and that occurs now once every 25 years, but is expected to occur once every 5 years by 2050 (Garner et al., 2017). This change in frequency of extreme floods has profound implications for the measures New York City should take to protect its infrastructure and its population, yet because of the stochastic nature of such events, this shift in flood frequency is an elevated risk that will go unnoticed by most people.

4. The combination of positive feedback loops and societal inertia is fertile ground for global environmental catastrophes.

Humans are remarkably ingenious, and have adapted to crises throughout their history. Our doom has been repeatedly predicted, only to be averted by innovation (Ridley, 2011). However, the many stories of human ingenuity successfully addressing existential risks such as global famine or extreme air pollution represent environmental challenges that are largely linear, have immediate consequences, and operate without positive feedbacks. For example, the fact that food is in short supply does not increase the rate at which humans consume food—thereby increasing the shortage. Similarly, massive air pollution episodes such as the London fog of 1952 that killed 12,000 people did not make future air pollution events more likely. In fact it was just the opposite—the London fog sent such a clear message that Britain quickly enacted pollution control measures (Stradling, 2016). Food shortages, air pollution, water pollution, etc. send immediate signals to society of harm, which then trigger a negative feedback of society seeking to reduce the harm.

In contrast, today’s great environmental crisis of climate change may cause some harm but there are generally long time delays between rising CO2 concentrations and damage to humans. The consequence of these delays are an absence of urgency; thus although 70% of Americans believe global warming is happening, only 40% think it will harm them (http://climatecommunication.yale.edu/visualizations-data/ycom-us-2016/). Secondly, unlike past environmental challenges, the Earth’s climate system is rife with positive feedback loops. In particular, as CO2 increases and the climate warms, that very warming can cause more CO2 release which further increases global warming, and then more CO2, and so on. Table 2 summarizes the best documented positive feedback loops for the Earth’s climate system. These feedbacks can be neatly categorized into carbon cycle, biogeochemical, biogeophysical, cloud, ice-albedo, and water vapor feedbacks. As important as it is to understand these feedbacks individually, it is even more essential to study the interactive nature of these feedbacks. Modeling studies show that when interactions among feedback loops are included, uncertainty increases dramatically and there is a heightened potential for perturbations to be magnified (e.g., Cox, Betts, Jones, Spall, & Totterdell, 2000; Hajima, Tachiiri, Ito, & Kawamiya, 2014; Knutti & Rugenstein, 2015; Rosenfeld, Sherwood, Wood, & Donner, 2014). This produces a wide range of future scenarios.

Positive feedbacks in the carbon cycle involves the enhancement of future carbon contributions to the atmosphere due to some initial increase in atmospheric CO2. This happens because as CO2 accumulates, it reduces the efficiency in which oceans and terrestrial ecosystems sequester carbon, which in return feeds back to exacerbate climate change (Friedlingstein et al., 2001). Warming can also increase the rate at which organic matter decays and carbon is released into the atmosphere, thereby causing more warming (Melillo et al., 2017). Increases in food shortages and lack of water is also of major concern when biogeophysical feedback mechanisms perpetuate drought conditions. The underlying mechanism here is that losses in vegetation increases the surface albedo, which suppresses rainfall, and thus enhances future vegetation loss and more suppression of rainfall—thereby initiating or prolonging a drought (Chamey, Stone, & Quirk, 1975). To top it off, overgrazing depletes the soil, leading to augmented vegetation loss (Anderies, Janssen, & Walker, 2002).

Climate change often also increases the risk of forest fires, as a result of higher temperatures and persistent drought conditions. The expectation is that forest fires will become more frequent and severe with climate warming and drought (Scholze, Knorr, Arnell, & Prentice, 2006), a trend for which we have already seen evidence (Allen et al., 2010). Tragically, the increased severity and risk of Southern California wildfires recently predicted by climate scientists (Jin et al., 2015), was realized in December 2017, with the largest fire in the history of California (the “Thomas fire” that burned 282,000 acres, https://www.vox.com/2017/12/27/16822180/thomas-fire-california-largest-wildfire). This catastrophic fire embodies the sorts of positive feedbacks and interacting factors that could catch humanity off-guard and produce a true apocalyptic event. Record-breaking rains produced an extraordinary flush of new vegetation, that then dried out as record heat waves and dry conditions took hold, coupled with stronger than normal winds, and ignition. Of course the record-fire released CO2 into the atmosphere, thereby contributing to future warming.

Out of all types of feedbacks, water vapor and the ice-albedo feedbacks are the most clearly understood mechanisms. Losses in reflective snow and ice cover drive up surface temperatures, leading to even more melting of snow and ice cover—this is known as the ice-albedo feedback (Curry, Schramm, & Ebert, 1995). As snow and ice continue to melt at a more rapid pace, millions of people may be displaced by flooding risks as a consequence of sea level rise near coastal communities (Biermann & Boas, 2010; Myers, 2002; Nicholls et al., 2011). The water vapor feedback operates when warmer atmospheric conditions strengthen the saturation vapor pressure, which creates a warming effect given water vapor’s strong greenhouse gas properties (Manabe & Wetherald, 1967).

Global warming tends to increase cloud formation because warmer temperatures lead to more evaporation of water into the atmosphere, and warmer temperature also allows the atmosphere to hold more water. The key question is whether this increase in clouds associated with global warming will result in a positive feedback loop (more warming) or a negative feedback loop (less warming). For decades, scientists have sought to answer this question and understand the net role clouds play in future climate projections (Schneider et al., 2017). Clouds are complex because they both have a cooling (reflecting incoming solar radiation) and warming (absorbing incoming solar radiation) effect (Lashof, DeAngelo, Saleska, & Harte, 1997). The type of cloud, altitude, and optical properties combine to determine how these countervailing effects balance out. Although still under debate, it appears that in most circumstances the cloud feedback is likely positive (Boucher et al., 2013). For example, models and observations show that increasing greenhouse gas concentrations reduces the low-level cloud fraction in the Northeast Pacific at decadal time scales. This then has a positive feedback effect and enhances climate warming since less solar radiation is reflected by the atmosphere (Clement, Burgman, & Norris, 2009).

The key lesson from the long list of potentially positive feedbacks and their interactions is that runaway climate change, and runaway perturbations have to be taken as a serious possibility. Table 2 is just a snapshot of the type of feedbacks that have been identified (see Supplementary material for a more thorough explanation of positive feedback loops). However, this list is not exhaustive and the possibility of undiscovered positive feedbacks portends even greater existential risks. The many environmental crises humankind has previously averted (famine, ozone depletion, London fog, water pollution, etc.) were averted because of political will based on solid scientific understanding. We cannot count on complete scientific understanding when it comes to positive feedback loops and climate change.

## Case

### 1NC – AT: Light Pollution

#### That’s not appropriation

#### That is not unique to private companies – all sats do that so the government still solves problems

### 1NC – AT: Living conditions

#### Not unique to space – and can be solved later

### 1NC – AT: Debris

#### Physics and math proofs prove no impact.

Cairncross 17 [Duncan Cairncross, Retired Planetary Science Engineer, BSc in Mechanical Engineering from the University of Glasgow, Diploma in Management DMS, Business Administration and Management, General from Teeside University, Former Asset Management Officer for the Gore District Council, “Is the Kessler Syndrome Disputed By Some Scientists?”, Quora, 10/25/2017, https://www.quora.com/Is-the-Kessler-Syndrome-disputed-by-some-scientists

Lets look at some numbers - we are talking LEO - so anything very small will de-orbit itself quite fast from atmospheric drag

These lumps are going the same direction - at similar speeds - as our satellites - so we are not talking about km/sec impacts - just rifle bullet speeds - 300 m/sec at maximum and the vast majority would have much much lower speeds

Everything is in a torus

Altitude 100 km to 300 km, - 1000 km North to 1000 km South - and about 40,000 km long

200 x 2000 x 40,000 = volume 16 billion cubic km -

18,000 Big bits - 100 mm - including 1,200 satellites

750,000 “bullets” - 10 mm

150 million bits 1 mm

Small bits we will ignore as they will not be going fast enough relative to our satellite to cause damage - and they will de-orbit quite fast

So one “bullet” for every 21,000 cubic km

That does not sound like too dangerous a neighborhood!

What happens if start some sort of cascade?

There is not much to cascade - 18,000 - “big bits” - if each of them became 1000 “bullets” then we would have 18 million “bullets” + the existing 750,000 bullets

And that is erring on the generous side - these bits are mostly metallic and metals don’t shatter into lots of 10 mm bits when hit by rifle bullets

That would be one “bullet” for every 853 cubic km AND most of the “bullets” will not actually be going very fast

Some time in the future when we have a lot mor,e as in a 100,000 times as much stuff in orbit then the Kessler Syndrome may be possible

If you are worried about communication satellites way up there in geostationary orbit then the situation is even better - there is a LOT more space up there and we have boosted a lot less junk up to those orbits

It is worth tracking the big bits and making sure that most satellites are safely de-orbited? - YES

But worrying about a Kessler Syndrome? - no not really

#### Long timeframe and squo solves

Kurt 15 [Joseph Kurt, JD- William & Mary School of Law, BA-Marquette University, NOTE: TRIUMPH OF THE SPACE COMMONS: ADDRESSING THE IMPENDING SPACE DEBRIS CRISIS WITHOUT AN INTERNATIONAL TREATY, 40 Wm. & Mary Envtl. L. & Pol'y Rev. 305 (2015)]

A. Practical Considerations: Feasible Solutions to the Space Debris Problem Are on Their Way

One key question in assessing whether an international treaty is a requisite for solving the space debris problem is just how difficult it will be to fashion a remedy. The more complex and costly are feasible solutions, the more likely it is that a comprehensive regime is necessary to bind the various actors together. 93Link to the text of the note

A good place to begin is to determine just how imminent is the onset of the cascade of exponentially more frequent debris-creating collisions, known as the Kessler Syndrome. 94Link to the text of the note To be certain, no one can be sure--this phenomenon being subject to highly complex probabilities. 95Link to the text of the note Indeed, experts' estimates of when such a cascade will become irreversible vary [\*316] widely. 96Link to the text of the note The National Research Council produced a report in 2011 that suggested that "space might be just 10 or 20 years away from severe problems." 97Link to the text of the note In fact, the cascading effect has already begun, albeit at a modest pace. 98Link to the text of the note However, Donald Kessler, who first described the eponymous effect in 1978, has significantly recalibrated his own outlook over the years. 99Link to the text of the note Originally, Kessler predicted that catastrophe would result by the year 2000. 100Link to the text of the note That date long passed, Kessler now speaks of a century-long process that "we have time to deal with." 101Link to the text of the note

Nevertheless, few would disagree with Cristophe Bonnal of the Centre National d'Études Spatiales ("CNES"), the French space agency, who says that it is "not yet clear" how much time we have to act. 102Link to the text of the note None of this is to say that interested parties should not act with great dispatch to address the space debris problem. Even if catastrophe is not on the immediate horizon--as some have suggested--Heiner Klinkrad, the European Space Agency's leading authority on space debris points out that "[t]he longer you wait, the more difficult and far more expensive" any solution will be. 103Link to the text of the note

The additional slack in plausible timelines is cause for optimism when one considers the progress being made towards remediating the problem of space debris. Such remediation entails a three-pronged approach: preventive measures to reduce the creation of new debris, 104Link to the text of the note space debris tracking technologies, 105Link to the text of the note and active debris removal ("ADR"). 106Link to the text of the note

In an effort to address the first prong, the United Nations General Assembly in 2007 endorsed the COPUOS Space Debris Mitigation Guidelines. 107Link to the text of the note The recommended measures include design changes which would [\*317] avoid the previously common practice of releasing debris during standard operations, refraining from intentional destruction of space objects, and limiting the risk of collisions through avoidance maneuvers and delaying launch times. 108Link to the text of the note As the COPUOS document points out, many of these practices had already been adopted by spacefaring nations. 109Link to the text of the note

Compliance with the COPUOS Mitigation Guidelines is voluntary and has not been universal; 110Link to the text of the note however, many nations do take steps beyond those called for in the Mitigation Guidelines, recognizing the importance of redressing the issue. 111Link to the text of the note That said, even if no nation ever again launched a single object into outer space, the operation of the Kessler Syndrome would ensure that, over time, continuing collisions amongst already present objects would result in Earth's orbit being rendered unusable. 112Link to the text of the note

Improvements in space debris tracking technology are another partial solution that promises to help actors avoid collisions by identifying orbital debris in the path of satellites or spacecraft. 113Link to the text of the note There are limits on the effectiveness of such tracking, however, including the inability of some optical systems to track objects at night. 114Link to the text of the note Moreover, commonly employed systems cannot continually track objects smaller than thirty centimeters in diameter. 115Link to the text of the note New systems are being developed, however, that will use lasers that can track the location of objects as small as a softball--sometimes to within one meter. 116Link to the text of the note Such technology is still at the planning stage for NASA, 117Link to the text of the note but Lockheed Martin is teaming up with an Australian-based company on a laser-tracking project already in the works. 118Link to the text of the note Another promising development comes from scientists at the Massachusetts Institute of Technology, who are working on soccer-ball-sized robots [\*318] designed to travel alongside the ISS, investigating potentially harmful space debris along the way. 119Link to the text of the note

But while tracking space debris can help avoid specific accidents, and thus slow the machinations of the Kessler Syndrome, only ADR can stabilize the space environment. 120Link to the text of the note

Fortunately, the targets for ADR that scientists believe will allow us to forestall an irreversible cascade of collisions are relatively modest. 121Link to the text of the note The most common estimate is that removing five to ten large pieces of debris per year is enough to keep the Kessler Syndrome at bay. 122Link to the text of the note And even more encouraging is that a broad array of national and private actors are exploring a plethora of ADR methods. 123Link to the text of the note For example, the Japanese hope to deploy, by 2019, a magnetic net that will draw pieces of space debris down to the Earth's atmosphere, where they will burn up. 124Link to the text of the note Such use of the atmosphere to incinerate debris is a common element of many ADR strategies, whether they employ nets, harpoons, tentacles, or ion thrusters to impact the debris. 125Link to the text of the note Meanwhile, a German Space Agency program is developing the means to robotically capture satellites. 126Link to the text of the note Other solutions include using enormous puffs of air, static electricity, or lasers to throw objects out of orbit. 127Link to the text of the note

Obviously, such projects carry a hefty price tag, but funding is coming in from a variety of sources. 128Link to the text of the note A laser-based project being developed by Australian National University, for example, received $ 20 million from the Australian government and an additional $ 130 million from NASA and other international public and private actors. 129Link to the text of the note But even these sums [\*319] are dwarfed by the $ 2 billion that Russia's leading space corporation, Energia, is investing in a nuclear-powered pod that it hopes to deploy by 2023. 130Link to the text of the note This pod will fly around space for fifteen years, knocking debris out of the atmosphere using an ion drive. 131Link to the text of the note

That substantial investments in ADR technologies have seemingly put us on the cusp of possessing the technology to stabilize the space environment significantly undermines claims that incentives to solve the orbital debris problem are lacking because of its nature as a "tragedy of the commons". 132Link to the text of the note Successful implementation of a solution is still years away--and can't be presumed. But taken together with the fact that we likely have a decades-long window to redress the problem, 133Link to the text of the note Col. Joseph Imburgia's 2011 warning that "a binding international agreement is needed to provide stability and order . . . and to preserve mankind's access to and through space" looks less and less prescient. 134Link to the text of the note

### 1NC - AT: Environment

**No enviro impact**

**Brook 13**

Barry Brook, Professor at the University of Adelaide, leading environmental scientist, holding the Sir Hubert Wilkins Chair of Climate Change at the School of Earth and Environmental Sciences, and is also Director of Climate Science at the University of Adelaide’s Environment Institute, author of 3 books and over 250 scholarly articles, Corey Bradshaw is an Associate Professor at the University of Adelaide and a joint appointee at the South Australian Research and Development Institute, Brave New Climate, March 4, 2013, "Worrying about global tipping points distracts from real planetary threats", http://bravenewclimate.com/2013/03/04/ecological-tipping-points/

Barry Brook We argue that at the global-scale, ecological “tipping points” and threshold-like “planetary boundaries” are improbable. **Instead, shifts in the Earth’s biosphere follow a gradual, smooth pattern**. This means that it might be impossible to define scientifically specific, critical levels of biodiversity loss or land-use change. This has important consequences for both science and policy. Humans are causing changes in ecosystems across Earth to such a degree that there is now broad agreement that we live in an epoch of our own making: the Anthropocene. But the question of just how these changes will play out — and especially whether we might be approaching a planetary tipping point with abrupt, global-scale consequences — has remained unsettled. A tipping point occurs when an ecosystem attribute, such as species abundance or carbon sequestration, responds abruptly and possibly irreversibly to a human pressure, such as land-use or climate change. Many local- and regional-level ecosystems, such as lakes,forests and grasslands, behave this way. Recently however, there have been several efforts to define ecological tipping points at the global scale. At a local scale, there are definitely warning signs that an ecosystem is about to “tip”. For the terrestrial biosphere, tipping points might be expected if ecosystems across Earth respond in similar ways to human pressures and these pressures are uniform, or if there are strong connections between continents that allow for rapid diffusion of impacts across the planet. These criteria are, however, unlikely to be met in the real world. First, **ecosystems on different continents are not strongly connected**. Organisms are limited in their movement by oceans and mountain ranges, as well as by climatic factors, and while ecosystem change in one region can affect the global circulation of, for example, greenhouse gases, this signal is likely to be weak in comparison with inputs from fossil fuel combustion and deforestation. Second, the responses of ecosystems to human pressures like climate change or land-use change depend on local circumstances and will therefore differ between locations. From a planetary perspective, this diversity in ecosystem responses creates an essentially gradual pattern of change, **without any identifiable tipping points**. This puts into question attempts to define critical levels of land-use change or biodiversity loss scientifically. Why does this matter? Well, one concern we have is that an undue focus on planetary tipping points may distract from the vast ecological transformations that have already occurred. After all, as much as four-fifths of the biosphere is today characterised by ecosystems that locally, over the span of centuries and millennia, have undergone human-driven regime shifts of one or more kinds. Recognising this reality and seeking appropriate conservation efforts at local and regional levels might be a more fruitful way forward for ecology and global change science. Corey Bradshaw (see also notes published here on ConservationBytes.com) Let’s not get too distracted by the title of the this article – Does the terrestrial biosphere have planetary tipping points? – or the potential for a false controversy. It’s important to be clear that the planet is indeed ill, and it’s largely due to us. Species are going extinct faster than they would have otherwise. The planet’s climate system is being severely disrupted; so is the carbon cycle. Ecosystem services are on the decline. But – and it’s a big “but” – we have to be wary of claiming the end of the world as we know it, or people will shut down and continue blindly with their growth and consumption obsession. We as scientists also have to be extremely careful not to pull concepts and numbers out of thin air without empirical support. Specifically, I’m referring to the latest “craze” in environmental science writing – the idea of “planetary tipping points” and the related “planetary boundaries”. **It’s really the stuff of Hollywood disaster blockbusters** – the world suddenly shifts into a new “state” where some major aspect of how the world functions does an immediate about-face. Don’t get me wrong: there are plenty of localised examples of such tipping points, often characterised by something we call “hysteresis”. Brook defines hysterisis as: a situation where the current state of an ecosystem is dependent not only on its environment but also on its history, with the return path to the original state being very different from the original development that led to the altered state. Also, at some range of the driver, there can exist two or more alternative states and “tipping point” as: the critical point at which strong nonlinearities appear in the relationship between ecosystem attributes and drivers; once a tipping point threshold is crossed, the change to a new state is typically rapid and might be irreversible or exhibit hysteresis. Some of these examples include state shifts that have happened (or mostly likely will) to the cryosphere, ocean thermohaline circulation, atmospheric circulation, and marine ecosystems, and there are many other fine-scale examples of ecological systems shifting to new (apparently) stable states. However, claiming that we are approaching a major planetary boundary for our ecosystems (including human society), where we witness such transitions simultaneously across the globe, **is simply not upheld by evidence**. Regional tipping points are unlikely to translate into planet-wide state shifts. The main reason is that **our ecosystems aren’t that connected at global scales**. The paper provides a framework against which one can test the existence or probability of a planetary tipping point for any particular ecosystem function or state. To date, the application of the idea has floundered because of a lack of specified criteria that would allow the terrestrial biosphere to “tip”. From a more sociological viewpoint, the claim of imminent shift to some worse state also risks alienating people from addressing the real problems (foxes), or as Brook and colleagues summarise: framing global change in the dichotomous terms implied by the notion of a global tipping point could lead to complacency on the “safe” side of the point and fatalism about catastrophic or irrevocable effects on the other. In other words, let’s be empirical about these sorts of politically charged statements instead of crying “Wolf!” while the hordes of foxes steal most of the flock.