### Innovation

#### Strong commercial space catalyzes tech innovation – progress at the margins and spinoff tech change global information networks

Joshua Hampson 2017, Security Studies Fellow at the Niskanen Center, 1-25-2017, “The Future of Space Commercialization”, Niskanen Center, https://republicans-science.house.gov/sites/republicans.science.house.gov/files/documents/TheFutureofSpaceCommercializationFinal.pdf

Innovation is generally hard to predict; some new technologies seem to come out of nowhere and others only take off when paired with a new application. It is difficult to predict the future, but it is reasonable to expect that a growing space economy would open opportunities for technological and organizational innovation. In terms of technology, the difficult environment of outer space helps incentivize progress along the margins. Because each object launched into orbit costs a significant amount of money—at the moment between $27,000 and $43,000 per pound, though that will likely drop in the future —each 19 reduction in payload size saves money or means more can be launched. At the same time, the ability to fit more capability into a smaller satellite opens outer space to actors that previously were priced out of the market. This is one of the reasons why small, affordable satellites are increasingly pursued by companies or organizations that cannot afford to launch larger traditional satellites. These small 20 satellites also provide non-traditional launchers, such as engineering students or prototypers, the opportunity to learn about satellite production and test new technologies before working on a full-sized satellite. That expansion of developers, experimenters, and testers cannot but help increase innovation opportunities. Technological developments from outer space have been applied to terrestrial life since the earliest days of space exploration. The National Aeronautics and Space Administration (NASA) maintains a website that lists technologies that have spun off from such research projects. Lightweight 21 nanotubes, useful in protecting astronauts during space exploration, are now being tested for applications in emergency response gear and electrical insulation. The need for certainty about the resiliency of materials used in space led to the development of an analytics tool useful across a range of industries. Temper foam, the material used in memory-foam pillows, was developed for NASA for seat covers. As more companies pursue their own space goals, more innovations will likely come from the commercial sector. Outer space is not just a catalyst for technological development. Satellite constellations and their unique line-of-sight vantage point can provide new perspectives to old industries. Deploying satellites into low-Earth orbit, as Facebook wants to do, can connect large, previously-unreached swathes of 22 humanity to the Internet. Remote sensing technology could change how whole industries operate, such as crop monitoring, herd management, crisis response, and land evaluation, among others. 23 While satellites cannot provide all essential information for some of these industries, they can fill in some useful gaps and work as part of a wider system of tools. Space infrastructure, in helping to change how people connect and perceive Earth, could help spark innovations on the ground as well. These innovations, changes to global networks, and new opportunities could lead to wider economic growth.

#### Tech innovation solves every existential threat – cumulative extinction events outweigh the aff

Dylan **Matthews 18**. Co-founder of Vox, citing Nick Beckstead @ Rutgers University. 10-26-2018. "How to help people millions of years from now." Vox. https://www.vox.com/future-perfect/2018/10/26/18023366/far-future-effective-altruism-existential-risk-doing-good

If you care about improving human lives, you should overwhelmingly care about those quadrillions of lives rather than the comparatively small number of people alive today. The 7.6 billion people now living, after all, amount to less than 0.003 percent of the population that will live in the future. It’s reasonable to suggest that those quadrillions of future people have, accordingly, hundreds of thousands of times more moral weight than those of us living here today do. That’s the basic argument behind Nick Beckstead’s 2013 Rutgers philosophy dissertation, “On the overwhelming importance of shaping the far future.” It’s a glorious mindfuck of a thesis, not least because Beckstead shows very convincingly that this is a conclusion any plausible moral view would reach. It’s not just something that weird utilitarians have to deal with. And Beckstead, to his considerable credit, walks the walk on this. He works at the Open Philanthropy Project on grants relating to the far future and runs a charitable fund for donors who want to prioritize the far future. And arguments from him and others have turned “long-termism” into a very vibrant, important strand of the effective altruism community. But what does prioritizing the far future even mean? The most literal thing it could mean is preventing human extinction, to ensure that the species persists as long as possible. For the long-term-focused effective altruists I know, that typically means identifying concrete threats to humanity’s continued existence — like unfriendly artificial intelligence, or a pandemic, or global warming/out of control geoengineering — and engaging in activities to prevent that specific eventuality. But in a set of slides he made in 2013, Beckstead makes a compelling case that while that’s certainly part of what caring about the far future entails, approaches that address specific threats to humanity (which he calls “targeted” approaches to the far future) have to complement “broad” approaches, where instead of trying to predict what’s going to kill us all, you just generally try to keep civilization running as best it can, so that it is, as a whole, well-equipped to deal with potential extinction events in the future, not just in 2030 or 2040 but in 3500 or 95000 or even 37 million. In other words, caring about the far future doesn’t mean just paying attention to low-probability risks of total annihilation; it also means acting on pressing needs now. For example: We’re going to be better prepared to prevent extinction from AI or a supervirus or global warming if society as a whole makes a lot of scientific progress. And a significant bottleneck there is that the vast majority of humanity doesn’t get high-enough-quality education to engage in scientific research, if they want to, which reduces the odds that we have enough trained scientists to come up with the breakthroughs we need as a civilization to survive and thrive. So maybe one of the best things we can do for the far future is to improve school systems — here and now — to harness the group economist Raj Chetty calls “lost Einsteins” (potential innovators who are thwarted by poverty and inequality in rich countries) and, more importantly, the hundreds of millions of kids in developing countries dealing with even worse education systems than those in depressed communities in the rich world. What if living ethically for the far future means living ethically now? Beckstead mentions some other broad, or very broad, ideas (these are all his descriptions): Help make computers faster so that people everywhere can work more efficiently Change intellectual property law so that technological innovation can happen more quickly Advocate for open borders so that people from poorly governed countries can move to better-governed countries and be more productive Meta-research: improve incentives and norms in academic work to better advance human knowledge Improve education Advocate for political party X to make future people have values more like political party X ”If you look at these areas (economic growth and technological progress, access to information, individual capability, social coordination, motives) a lot of everyday good works contribute,” Beckstead writes. “An implication of this is that a lot of everyday good works are good from a broad perspective, even though hardly anyone thinks explicitly in terms of far future standards.” Look at those examples again: It’s just a list of what normal altruistically motivated people, not effective altruism folks, generally do. Charities in the US love talking about the lost opportunities for innovation that poverty creates. Lots of smart people who want to make a difference become scientists, or try to work as teachers or on improving education policy, and lord knows there are plenty of people who become political party operatives out of a conviction that the moral consequences of the party’s platform are good. All of which is to say: Maybe effective altruists aren’t that special, or at least maybe we don’t have access to that many specific and weird conclusions about how best to help the world. If the far future is what matters, and generally trying to make the world work better is among the best ways to help the far future, then effective altruism just becomes plain ol’ do-goodery.\*

### Biz con

#### Unpredictable shifts ruin biz con AND overall growth

Sarah Chaney Cambon 21, Reporter on The Wall Street Journal's Economics Team, BA in Business Journalism from the University of North Carolina-Chapel Hill, “Capital-Spending Surge Further Lifts Economic Recovery”, Wall Street Journal, 6/27/2021, https://www.wsj.com/articles/capital-spending-surge-further-lifts-economic-recovery-11624798800

Business investment is emerging as a powerful source of U.S. economic growth that will likely help sustain the recovery.

Companies are ramping up orders for computers, machinery and software as they grow more confident in the outlook.

Nonresidential fixed investment, a proxy for business spending, rose at a seasonally adjusted annual rate of 11.7% in the first quarter, led by growth in software and tech-equipment spending, according to the Commerce Department. Business investment also logged double-digit gains in the third and fourth quarters last year after falling during pandemic-related shutdowns. It is now higher than its pre-pandemic peak.

Orders for nondefense capital goods excluding aircraft, another measure for business investment, are near the highest levels for records tracing back to the 1990s, separate Commerce Department figures show.

“Business investment has really been an important engine powering the U.S. economic recovery,” said Robert Rosener, senior U.S. economist at Morgan Stanley. “In our outlook for the economy, it’s certainly one of the bright spots.”

Consumer spending, which accounts for about two-thirds of economic output, is driving the early stages of the recovery. Americans, flush with savings and government stimulus checks, are spending more on goods and services, which they shunned for much of the pandemic.

Robust capital investment will be key to ensuring that the recovery maintains strength after the spending boost from fiscal stimulus and business reopenings eventually fades, according to some economists.

Rising business investment helps fuel economic output. It also lifts worker productivity, or output per hour. That metric grew at a sluggish pace throughout the last economic expansion but is now showing signs of resurgence.

The recovery in business investment is shaping up to be much stronger than in the years following the 2007-09 recession. “The events especially in late ’08, early ’09 put a lot of businesses really close to the edge,” said Phil Suttle, founder of Suttle Economics. “I think a lot of them said, ‘We’ve just got to be really cautious for a long while.’”

Businesses appear to be less risk-averse now, he said.

After the financial crisis, businesses grew by adding workers, rather than investing in capital. Hiring was more attractive than capital spending because labor was abundant and relatively cheap. Now the supply of workers is tight. Companies are raising pay to lure employees. As a result, many firms have more incentive to grow by investing in capital.

Economists at Morgan Stanley predict that U.S. capital spending will rise to 116% of prerecession levels after three years. By comparison, investment took 10 years to reach those levels once the 2007-09 recession hit.

Company executives are increasingly confident in the economy’s trajectory. The Business Roundtable’s economic-outlook index—a composite of large companies’ plans for hiring and spending, as well as sales projections—increased by nine points in the second quarter to 116, just below 2018’s record high, according to a survey conducted between May 25 and June 9. In the second quarter, the share of companies planning to boost capital investment increased to 59% from 57% in the first.

“We’re seeing really strong reopening demand, and a lot of times capital investment follows that,” said Joe Song, senior U.S. economist at BofA Securities.

Mr. Song added that less uncertainty regarding trade tensions between the U.S. and China should further underpin business confidence and investment. “At the very least, businesses will understand the strategy that the Biden administration is trying to follow and will be able to plan around that,” he said.

#### Policy uncertainty wrecks biz con, drying up investment

Gabriel Caldas Montes 21, PhD Candidate in the Department of Economics at Fluminense Federal University and Fabiana da Silva Dr. Leite Nogueira, PhD in Economics from Universidade Federal Fluminense, Professor of Economics at the Universidade de Vassouras, “Effects of Economic Policy Uncertainty and Political Uncertainty on Business Confidence and Investment”, Journal of Economic Studies, April 2021, Emerald Insights

The findings indicate that increases in political uncertainty and economic policy uncertainty reduce business confidence. Regarding the role of confidence as a transmission channel, the findings show that business confidence acts as a transmission channel of political uncertainty and economic policy uncertainty to investment. Increases in political uncertainty and economic policy uncertainty adversely influence investment through reduced business confidence.

From the findings of this study, we can point out the following policy suggestions. Policymakers must strengthen institutions through the development and use of rules that prevent irresponsible actions and are capable of destabilizing the political scenario, and they should establish management practices based on greater levels of transparency and communication with the public in order to better guide expectations and promote an environment that enhance business confidence. Positive evaluations about the government, about the management of public affairs, as well as about the chief executive, tend to generate a more optimistic business environment, positively influencing business investment decisions. Thus, policymakers should adopt credible economic policies that promote a more stable business environment with less uncertainty, allowing entrepreneurs to plan and make investment decisions with a view to a longer time horizon.

#### Decline cascades---nuclear war

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Various scholars and institutions regard global social instability as the greatest threat facing this decade. The catalyst has been postulated to be a Second Great Depression which, in turn, will have profound implications for global security and national integrity. This paper, written from a broad systems perspective, illustrates how emerging risks are getting more complex and intertwined; blurring boundaries between the economic, environmental, geopolitical, societal and technological taxonomy used by the World Economic Forum for its annual global risk forecasts. Tight couplings in our global systems have also enabled risks accrued in one area to snowball into a full-blown crisis elsewhere. The COVID-19 pandemic and its socioeconomic fallouts exemplify this systemic chain-reaction. Onceinexorable forces of globalization are rupturing as the current global system can no longer be sustained due to poor governance and runaway wealth fractionation. The coronavirus pandemic is also enabling Big Tech to expropriate the levers of governments and mass communications worldwide. This paper concludes by highlighting how this development poses a dilemma for security professionals.

Key Words: Global Systems, Emergence, VUCA, COVID-9, Social Instability, Big Tech, Great Reset

INTRODUCTION

The new decade is witnessing rising volatility across global systems. Pick any random “system” today and chart out its trajectory: Are our education systems becoming more robust and affordable? What about food security? Are our healthcare systems improving? Are our pension systems sound? Wherever one looks, there are dark clouds gathering on a global horizon marked by volatility, uncertainty, complexity and ambiguity (VUCA).

But what exactly is a global system? Our planet itself is an autonomous and selfsustaining mega-system, marked by periodic cycles and elemental vagaries. Human activities within however are not system isolates as our banking, utility, farming, healthcare and retail sectors etc. are increasingly entwined. Risks accrued in one system may cascade into an unforeseen crisis within and/or without (Choo, Smith & McCusker, 2007). Scholars call this phenomenon “emergence”; one where the behaviour of intersecting systems is determined by complex and largely invisible interactions at the substratum (Goldstein, 1999; Holland, 1998).

The ongoing COVID-19 pandemic is a case in point. While experts remain divided over the source and morphology of the virus, the contagion has ramified into a global health crisis and supply chain nightmare. It is also tilting the geopolitical balance. China is the largest exporter of intermediate products, and had generated nearly 20% of global imports in 2015 alone (Cousin, 2020). The pharmaceutical sector is particularly vulnerable. Nearly “85% of medicines in the U.S. strategic national stockpile” sources components from China (Owens, 2020).

An initial run on respiratory masks has now been eclipsed by rowdy queues at supermarkets and the bankruptcy of small businesses. The entire global population – save for major pockets such as Sweden, Belarus, Taiwan and Japan – have been subjected to cyclical lockdowns and quarantines. Never before in history have humans faced such a systemic, borderless calamity.

COVID-19 represents a classic emergent crisis that necessitates real-time response and adaptivity in a real-time world, particularly since the global Just-in-Time (JIT) production and delivery system serves as both an enabler and vector for transboundary risks. From a systems thinking perspective, emerging risk management should therefore address a whole spectrum of activity across the economic, environmental, geopolitical, societal and technological (EEGST) taxonomy. Every emerging threat can be slotted into this taxonomy – a reason why it is used by the World Economic Forum (WEF) for its annual global risk exercises (Maavak, 2019a). As traditional forces of globalization unravel, security professionals should take cognizance of emerging threats through a systems thinking approach.

METHODOLOGY

An EEGST sectional breakdown was adopted to illustrate a sampling of extreme risks facing the world for the 2020-2030 decade. The transcendental quality of emerging risks, as outlined on Figure 1, below, was primarily informed by the following pillars of systems thinking (Rickards, 2020):

• Diminishing diversity (or increasing homogeneity) of actors in the global system (Boli & Thomas, 1997; Meyer, 2000; Young et al, 2006);

• Interconnections in the global system (Homer-Dixon et al, 2015; Lee & Preston, 2012);

• Interactions of actors, events and components in the global system (Buldyrev et al, 2010; Bashan et al, 2013; Homer-Dixon et al, 2015); and

• Adaptive qualities in particular systems (Bodin & Norberg, 2005; Scheffer et al, 2012) Since scholastic material on this topic remains somewhat inchoate, this paper buttresses many of its contentions through secondary (i.e. news/institutional) sources.

ECONOMY

According to Professor Stanislaw Drozdz (2018) of the Polish Academy of Sciences, “a global financial crash of a previously unprecedented scale is highly probable” by the mid- 2020s. This will lead to a trickle-down meltdown, impacting all areas of human activity.

The economist John Mauldin (2018) similarly warns that the “2020s might be the worst decade in US history” and may lead to a Second Great Depression. Other forecasts are equally alarming. According to the International Institute of Finance, global debt may have surpassed $255 trillion by 2020 (IIF, 2019). Yet another study revealed that global debts and liabilities amounted to a staggering $2.5 quadrillion (Ausman, 2018). The reader should note that these figures were tabulated before the COVID-19 outbreak.

The IMF singles out widening income inequality as the trigger for the next Great Depression (Georgieva, 2020). The wealthiest 1% now own more than twice as much wealth as 6.9 billion people (Coffey et al, 2020) and this chasm is widening with each passing month. COVID-19 had, in fact, boosted global billionaire wealth to an unprecedented $10.2 trillion by July 2020 (UBS-PWC, 2020). Global GDP, worth $88 trillion in 2019, may have contracted by 5.2% in 2020 (World Bank, 2020).

As the Greek historian Plutarch warned in the 1st century AD: “An imbalance between rich and poor is the oldest and most fatal ailment of all republics” (Mauldin, 2014). The stability of a society, as Aristotle argued even earlier, depends on a robust middle element or middle class. At the rate the global middle class is facing catastrophic debt and unemployment levels, widespread social disaffection may morph into outright anarchy (Maavak, 2012; DCDC, 2007).

Economic stressors, in transcendent VUCA fashion, may also induce radical geopolitical realignments. Bullions now carry more weight than NATO’s security guarantees in Eastern Europe. After Poland repatriated 100 tons of gold from the Bank of England in 2019, Slovakia, Serbia and Hungary quickly followed suit.

According to former Slovak Premier Robert Fico, this erosion in regional trust was based on historical precedents – in particular the 1938 Munich Agreement which ceded Czechoslovakia’s Sudetenland to Nazi Germany. As Fico reiterated (Dudik & Tomek, 2019):

“You can hardly trust even the closest allies after the Munich Agreement… I guarantee that if something happens, we won’t see a single gram of this (offshore-held) gold. Let’s do it (repatriation) as quickly as possible.” (Parenthesis added by author).

President Aleksandar Vucic of Serbia (a non-NATO nation) justified his central bank’s gold-repatriation program by hinting at economic headwinds ahead: “We see in which direction the crisis in the world is moving” (Dudik & Tomek, 2019). Indeed, with two global Titanics – the United States and China – set on a collision course with a quadrillions-denominated iceberg in the middle, and a viral outbreak on its tip, the seismic ripples will be felt far, wide and for a considerable period.

A reality check is nonetheless needed here: Can additional bullions realistically circumvallate the economies of 80 million plus peoples in these Eastern European nations, worth a collective $1.8 trillion by purchasing power parity? Gold however is a potent psychological symbol as it represents national sovereignty and economic reassurance in a potentially hyperinflationary world. The portents are clear: The current global economic system will be weakened by rising nationalism and autarkic demands. Much uncertainty remains ahead. Mauldin (2018) proposes the introduction of Old Testament-style debt jubilees to facilitate gradual national recoveries. The World Economic Forum, on the other hand, has long proposed a “Great Reset” by 2030; a socialist utopia where “you’ll own nothing and you’ll be happy” (WEF, 2016).

In the final analysis, COVID-19 is not the root cause of the current global economic turmoil; it is merely an accelerant to a burning house of cards that was left smouldering since the 2008 Great Recession (Maavak, 2020a). We also see how the four main pillars of systems thinking (diversity, interconnectivity, interactivity and “adaptivity”) form the mise en scene in a VUCA decade.

ENVIRONMENTAL

What happens to the environment when our economies implode? Think of a debt-laden workforce at sensitive nuclear and chemical plants, along with a concomitant surge in industrial accidents? Economic stressors, workforce demoralization and rampant profiteering – rather than manmade climate change – arguably pose the biggest threats to the environment. In a WEF report, Buehler et al (2017) made the following pre-COVID-19 observation:

The ILO estimates that the annual cost to the global economy from accidents and work-related diseases alone is a staggering $3 trillion. Moreover, a recent report suggests the world’s 3.2 billion workers are increasingly unwell, with the vast majority facing significant economic insecurity: 77% work in part-time, temporary, “vulnerable” or unpaid jobs.

Shouldn’t this phenomenon be better categorized as a societal or economic risk rather than an environmental one? In line with the systems thinking approach, however, global risks can no longer be boxed into a taxonomical silo. Frazzled workforces may precipitate another Bhopal (1984), Chernobyl (1986), Deepwater Horizon (2010) or Flint water crisis (2014). These disasters were notably not the result of manmade climate change. Neither was the Fukushima nuclear disaster (2011) nor the Indian Ocean tsunami (2004). Indeed, the combustion of a long-overlooked cargo of 2,750 tonnes of ammonium nitrate had nearly levelled the city of Beirut, Lebanon, on Aug 4 2020. The explosion left 204 dead; 7,500 injured; US$15 billion in property damages; and an estimated 300,000 people homeless (Urbina, 2020). The environmental costs have yet to be adequately tabulated.

Environmental disasters are more attributable to Black Swan events, systems breakdowns and corporate greed rather than to mundane human activity.

Our JIT world aggravates the cascading potential of risks (Korowicz, 2012). Production and delivery delays, caused by the COVID-19 outbreak, will eventually require industrial overcompensation. This will further stress senior executives, workers, machines and a variety of computerized systems. The trickle-down effects will likely include substandard products, contaminated food and a general lowering in health and safety standards (Maavak, 2019a). Unpaid or demoralized sanitation workers may also resort to indiscriminate waste dumping. Many cities across the United States (and elsewhere in the world) are no longer recycling wastes due to prohibitive costs in the global corona-economy (Liacko, 2021).

Even in good times, strict protocols on waste disposals were routinely ignored. While Sweden championed the global climate change narrative, its clothing flagship H&M was busy covering up toxic effluences disgorged by vendors along the Citarum River in Java, Indonesia. As a result, countless children among 14 million Indonesians straddling the “world’s most polluted river” began to suffer from dermatitis, intestinal problems, developmental disorders, renal failure, chronic bronchitis and cancer (DW, 2020). It is also in cauldrons like the Citarum River where pathogens may mutate with emergent ramifications.

On an equally alarming note, depressed economic conditions have traditionally provided a waste disposal boon for organized crime elements. Throughout 1980s, the Calabriabased ‘Ndrangheta mafia – in collusion with governments in Europe and North America – began to dump radioactive wastes along the coast of Somalia. Reeling from pollution and revenue loss, Somali fisherman eventually resorted to mass piracy (Knaup, 2008).

The coast of Somalia is now a maritime hotspot, and exemplifies an entwined form of economic-environmental-geopolitical-societal emergence. In a VUCA world, indiscriminate waste dumping can unexpectedly morph into a Black Hawk Down incident. The laws of unintended consequences are governed by actors, interconnections, interactions and adaptations in a system under study – as outlined in the methodology section.

Environmentally-devastating industrial sabotages – whether by disgruntled workers, industrial competitors, ideological maniacs or terrorist groups – cannot be discounted in a VUCA world. Immiserated societies, in stark defiance of climate change diktats, may resort to dirty coal plants and wood stoves for survival. Interlinked ecosystems, particularly water resources, may be hijacked by nationalist sentiments. The environmental fallouts of critical infrastructure (CI) breakdowns loom like a Sword of Damocles over this decade.

GEOPOLITICAL

The primary catalyst behind WWII was the Great Depression. Since history often repeats itself, expect familiar bogeymen to reappear in societies roiling with impoverishment and ideological clefts. Anti-Semitism – a societal risk on its own – may reach alarming proportions in the West (Reuters, 2019), possibly forcing Israel to undertake reprisal operations inside allied nations. If that happens, how will affected nations react? Will security resources be reallocated to protect certain minorities (or the Top 1%) while larger segments of society are exposed to restive forces? Balloon effects like these present a classic VUCA problematic.

Contemporary geopolitical risks include a possible Iran-Israel war; US-China military confrontation over Taiwan or the South China Sea; North Korean proliferation of nuclear and missile technologies; an India-Pakistan nuclear war; an Iranian closure of the Straits of Hormuz; fundamentalist-driven implosion in the Islamic world; or a nuclear confrontation between NATO and Russia. Fears that the Jan 3 2020 assassination of Iranian Maj. Gen. Qasem Soleimani might lead to WWIII were grossly overblown. From a systems perspective, the killing of Soleimani did not fundamentally change the actor-interconnection-interaction adaptivity equation in the Middle East. Soleimani was simply a cog who got replaced.

### Balloons CP---1NC

The United States federal government should fund the deployment of balloon technology for drought surveillance, agriculture surveillance, and functions for keeping grid up like gps

#### Balloons can replace satellites – new tech advances overcome barriers

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Isaac Newton first theorized in 1687 that a projectile shot with enough force would break free of Earth’s gravity, subsequently falling into continuous orbit.1 It would be over two hundred years before the Soviets would begin to harness this aspect of the space domain theorized by Newton with the first satellite, Sputnik, igniting the space race that produced manned spaceflight and today’s ubiquitous orbiting satellite capabilities.

For the United States, conquering the space domain with its own satellites required political will, deliberate and targeted government investment, and incremental technical progress. This same grit and persistence is necessary to master the high-altitude domain with other vehicles adapted to the task. This article characterizes the high-altitude domain, explains recent scientific advances that are finally enabling the technology, and identifies the risks of pursuing high altitude for military use.

The High-Altitude Domain

Also called “near space,” high altitude most commonly refers to the upper stratosphere roughly from sixty thousand to one hundred thousand feet above the ground, and there are two starkly different designs competing for dominance: heavier than air (HTA) and lighter than air (LTA).

The HTA crafts are closer to a classic aircraft design, dependent on long wingspans, commensurately long solar arrays, and propellers to maintain sufficient speed to prevent stalling.2 The LTA design is a balloon-centric vehicle containing an altitude-controlling expansive element (usually helium or hydrogen) that provides lift.

While each design presents unique engineering and operational opportunities, the balloon design is the focus of this essay.3 Intuitively, balloons at such heights could perform missions such as intelligence, surveillance and reconnaissance, communications, missile warning, and precision navigation and timing. As the space domain becomes increasingly precarious, balloons offer resilience and redundancy against overhead capability shortfalls. In regard to the operational and tactical levels of war, this technology could allow commanders to surge mission-tailored effects on demand, augment network capacity, quickly reconstitute lost assets, and integrate payloads into dedicated mission architectures—and do it at a fraction of the cost of satellites. But while we may have crossed a technological threshold that greatly increases the viability of high-altitude balloons, harnessing the power of this inhospitable domain will depend in part on conquering meteorology and physics.

Perhaps the most important aspect of this domain is that at roughly sixty-five thousand feet there is relatively less wind, which theoretically allows for a platform to maintain semigeosynchronous station keeping (the ability to maintain relative presence at a specific altitude) with minimum energy expenditure. In other words, there is a “sweet spot” in the atmosphere that should allow for long overhead-loitering capability.

But winds are diminished at high altitude, not absent, and as balloons are objects in flight, they are at the mercy of physics and basic aeronautical engineering. The large surface area of these vehicles mean high drag, even in the reduced atmosphere of high altitude. Without active means to resist, the natural tendency for balloons is to move with the prevailing winds. This lack of geostationary presence is their major operational shortcoming. Stratospheric weather is variable, dependent on season and latitude, with some regions being relatively inhospitable to high-altitude operations, especially in certain tumultuous latitudes (such as those above the Balkans and North Korea).4

Alas, maintaining relative position against the wind is not the only obstacle high-altitude balloons must overcome. High altitude is fraught with environmental dangers. Surging wind gusts are especially dangerous and can threaten the structural integrity of the craft. Also, elevated ultraviolet (UV) radiation and ozone concentrations at altitude have a tendency to weaken materials, shortening available loiter time.5 Additionally, severe temperature swings in the stratosphere also impact both the payload and platform operations.

Without the ability to maintain location and overcome the natural forces found at high altitudes, the capability of these platforms to replicate space capabilities is severely limited. Luckily, with new designs and operational techniques, the high-altitude industry seems to be advancing in the face of these inhospitable conditions.

New Advances in High-Altitude Balloons

Significant advances in material science and navigation techniques have invigorated the potential for balloons as a viable military technology. One of the world’s most innovative firms, Google, has been developing high-altitude balloon technology to deliver the internet to less-connected regions such as Sri Lanka, Puerto Rico, and parts of South America.6 Google’s high-altitude division, called Loon, also plans on delivering internet access via balloon to Kenya in 2019.7 Other companies, such as Arizona-based World View, have also made serious advances in high-altitude balloons.8 Based on the commercial interest alone, the technology should be piquing the U.S. military’s interest.

The basics of evaluating high-altitude vehicles are rather straightforward. The engineering requirement is to optimize the trade spaces of size, weight, and power of the platform.9 The total weight of the platform is linear in terms of the size, which means the heavier the total weight of the system, the larger the balloon needed. In contrast, the platform size is exponential in terms of the altitude desired. In other words, the higher the altitude, the greater the external pressure, and thus the stronger the balloon needs to be (in terms of material, size, and shape).10 This is why some of these balloons expand to enormous size. For example, while blimps commonly found at sporting events are considered large, the same blimps at high altitude would be massive, some larger than a football field.11 Again, an increase in overall aircraft weight (platform and payload) causes a linear increase in its volume, but increases in altitude require a corresponding exponential increase in volume. So the heavier and higher the balloon, the larger it is.

The third major design characteristic is power, and it encompasses both strength and weight. For a majority of high-altitude designs, solar energy is currently the predominant source of power. Unfortunately, available solar energy fluctuates by season and latitude.12 Throughout the day, the average position of the craft’s solar array relative to the sun does not allow for optimal solar collection. Additionally, the weight and size restriction of energy storage systems are limiting. In seasons of favorable solar collection, the added weight of robust energy storage is a liability to the overall system.13 Solar power technology in the near future is unlikely to be capable of effectively powering the maneuverability of high-altitude aircraft, even in the most favorable range of latitudes and the calmest of seasons.14 These variations in winds and solar availability are frequently unsynchronized, meaning those times when power is least available may be when it is most needed.

Balloon Construction

Balloons are only as good as the materials that compose them. The state-of-the-art balloon material is an extremely thin and relatively lightweight film of polyurethane blends.15 Only a few microns thick, these plastics-based materials are able to withstand extreme temperature changes in the stratosphere and the increased solar radiation and ozone effects, all while expanding many multiples of its original (ground level) inflated size.16 While these balloons have recently maintained altitude for over 180 days, staying aloft is a necessary but insufficient component in providing a useful capability.17

To make use of high altitude, it is necessary for these balloons to maintain a presence relative to a location on the earth. The winds in the stratosphere tend to move relatively horizontally and in different directions based on altitude.18 The ability to change altitudes enables a vehicle to take advantage of this meteorological phenomenon and navigate to maintain a semi-stable presence. Basically, the balloon rises or falls to get into the wind current moving in the desired direction. Current balloon technology accomplishes this change in altitude by increasing or decreasing the balloon’s mass by pumping ambient air into and out of a separate section of the balloon called a ballonet. At altitude, this minor change in mass causes a corresponding rise or fall in the balloon, enabling it to change direction based on the wind patterns. It follows then that the operational problem now becomes discerning these high-altitude wind directions.

Until recently, science and industry have largely neglected high-altitude weather patterns. Although there has been plenty of scientific examination of the winds and temperature within the stratosphere, the application of these data to balloon maneuvers has not been a major consideration.19 And although some weather data exists, archival data may be as useful to high-altitude flight as almanacs are to sailing. The extreme variance in stratospheric winds will necessitate more real-time weather evaluation. In other words, balloon pilots will most likely need to gather a vast majority of wind data during actual operations. The inclusion of new data science techniques, including artificial intelligence and deep learning, may also increase the viability of balloon navigation.

Moving Forward

Like cicadas emerging from hibernation, the scientific community cyclically revives and then summarily dismisses the quest for high altitude. Because the design of this technology encompasses such broad criteria (size, weight, and power), almost any advancement to modern science applies to its development. Consequently, any marked advance in material seems to spur an investigation into the renewed promise of near space. For example, motivated by advances in Kevlar—a lightweight fiber commonly used in body armor—a 1977 U.S. Navy study into high-altitude vehicles determined that advances in “modern materials, structural concepts, methods of analysis, and fabrication techniques will surely make airship structures lighter, stronger, and more efficient.”20

How can we determine if balloon technology is ready for serious consideration as a viable military technology? New technology is often wrought with information asymmetries (information about the performance of the device or procedure known to only the inventors or developers), the existence of which often makes technology evaluation difficult. One of the fortunate characteristics of high altitude is that the performance criteria are rather straightforward. The vehicle must carry a payload of a specified weight at a certain height, stay aloft for a predetermined amount of time, maintain position relative to a point on the earth, and provide sufficient power to the payload. The vehicle either accomplishes these simple criteria or it does not.

Although the evaluation criteria may be intuitive, the Department of Defense must avoid knee-jerk research funding of extravagant programs, the kind that have failed extravagantly in the recent past. Periodic resurgence of interest in the high-altitude domain seems to cause periods of irrational exuberance and enthusiastic spending. Convinced that the technology is suddenly viable, government agencies pursue large research-and-development undertakings, and these programs often make unreasonable demands with untested technologies and inexperienced developers, resulting in inevitable failure. These acquisition debacles embarrass the responsible organizations, but even worse, they stagnate high-altitude research-and-development spending.21

Perhaps the military needs to start small but continue steadily. For example, the Manhattan Project cost the United States $22 billion in current dollars.22 At the same time, for roughly $20 million, the military was conducting another secret research project using bats to incinerate Japanese structures.23 The project called for releasing the bats with tiny incendiary devices attached to their legs over a Japanese city, wherein they would instinctively find refuge in the decorative awnings and structural under-hangings. Once safely ensconced, a timer would detonate the attached devices, burning buildings and consequently the city. The “bat bomb” tests conducted on mock cities were successful, perhaps too successful, as one of the tests almost burned down the historic Carlsbad Army Airfield Base in Carlsbad, New Mexico.24

High-altitude balloons are similar to the bat bomb in that they are relatively cheap and effective. But the government must be careful not to incinerate the opportunity to replicate space capabilities just because these balloons are, compared to satellites, inexpensive. In discussion with the author, one high-altitude balloon manufacturer estimated the initial development and operating costs for one balloon at $100,000; compare this to the $1.6 billion each space-based infrared satellite costs.25 Like the Manhattan Project, a majority of the recent government programs that have attempted to use high altitude have been extravagant, costly undertakings. However, in the near term, these simple balloons present less technical risk, and they may be ready to populate the stratosphere now. If recent civilian operations are telling, these balloons are sufficiently advanced to maintain a long-endurance presence in the stratosphere while carrying and supplying power to a functional payload. As the space domain becomes more difficult to maintain, our government needs a viable alternative. Given the possibility of a much publicized “impending war in space,” should the Department of Defense not entertain relatively inexpensive solutions to this space dilemma?26

Conclusion

Recent advances in diverse technological frontiers such as materials and information sciences have reignited hope in harnessing the high-altitude domain. But before balloons can supplant satellites, the technology has to overcome some serious limitations. The solution to maintaining balloon presence is mastering the winds. And although balloon navigation is still in its nascent stages, archival data, experimentation, preoperational flights, and predictive algorithms could eventually allow a functional geostationary presence at most latitudes and in most seasons.

Most importantly, our government must avoid wasteful mistakes that tarnish the idea of using high altitude. Past enthusiasm in high altitude has been akin to the clairvoyant financial “guru” who adamantly proclaims that the stock market is going to crash, although history dictates it will crash eventually. Likewise, it is inevitable that technology will eventually enable high-altitude vehicles to replicate much of the current space capabilities. In the future, advanced algorithms, weather sensors, autonomous flight, advanced artificial intelligence, and data science should help improve station keeping and enhance the viability of the balloon concept. But for the military to develop and implement these technologies will require incremental investment, learning, and patience.

#### Balloons are a hundred thousand feet up.

Tingle 19—(chief of strategy, policy, and doctrine at the Joint Force Space Component Command, Vandenberg Air Force Base, California. He holds a BS in systems engineering from West Point; a master of engineering and an MBA from the University of Colorado, Colorado Springs; and a PhD in public policy from George Mason University) Lt. Col. Anthony Tingle. “When the Balloon Goes Up” Army University Press. May-June 2019. Accessed August 31, 2019. https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/May-June-2019/Tingle-High-Alt-Balloon/

The High-Altitude Domain Also called “near space,” high altitude most commonly refers to the upper stratosphere roughly from sixty thousand to one hundred thousand feet above the ground, and there are two starkly different designs competing for dominance: heavier than air (HTA) and lighter than air (LTA).

#### That’s low enough to avoid debris.

Wei-Haas 19—(science writer at National Geographic, PHD in environmental chemistry from Ohio State). Wei-Haas, Maya. 2019. “Space Junk Facts and Information.” National Geographic, April 25, 2019. <https://webcache.googleusercontent.com/search?q=cache:_CFIdLfq0b0J:https://www.nationalgeographic.com/science/space/reference/space-junk/+&cd=13&hl=en&ct=clnk&gl=us>. Accessed 9/20/19.

Most of that debris sits within 1,250 miles of Earth's surface in what is known as low Earth orbit, home to lots of satellites, such as NASA’s Earth Observing System fleet and the International Space Station. And while space is big—so even 23,000 fragments tend to be far from each other—even the tiniest bits of man-made flotsam can be problematic for active earth orbiters because of their breakneck speeds.

#### Balloons are specifically suitable for ag.

Dorminey 16—(science writer, former Hong Kong bureau chief for Aviation Week & Space Technology). Dorminey, Bruce. 2016. “Stratospheric ‘Space-Balloons’ Set To Revolutionize Global Satellite Industry.” Forbes. June 30, 2016. https://www.forbes.com/sites/brucedorminey/2016/06/30/stratospheric-space-balloons-set-to-revolutionize-global-satellite-industry/.

“The payload would simply descend back down to Earth beneath a guided parafoil for a gentle-impact landing,” said Antonio. And while mission applications are still being devised, three areas are certain to be included in World View’s stratollite business plan. They include: --- Communications – To aid first responders in their efforts to locate and assist those in distress. To build constellations of stratollites that affordably deliver cellular device signals to Third World populations. And rapidly deployment of communications systems for troops in the field. --- Remote sensing – For real-time, continuous visual data for agricultural monitoring for farmers or even commodities traders. For the study of city traffic patterns. And for advertisers looking to better target brick–and--mortar customers by literally studying their traffic into niche geographic markets. --- Weather – For the collection of critical, in-situ weather data over remote parts of the ocean where weather systems often develop and conventional observational systems are lacking.

#### Turns case: satellites in the aff world could be destroyed leading to impacts, but if we have balloons as an alternative we won’t have to worry about satellites rn being destroyed, so we turn their case and solve better.

### Mining---1NC

#### Loss of satellites will shut down terrestrial mining

Les Johnson 13, Deputy Manager for NASA's Advanced Concepts Office at the Marshall Space Flight Center, Co-Investigator for the JAXA T-Rex Space Tether Experiment and PI of NASA's ProSEDS Experiment, Master's Degree in Physics from Vanderbilt University, Popular Science Writer, and NASA Technologist, Frequent Contributor to the Journal of the British Interplanetary Society and Member of the American Institute of Aeronautics and Astronautics, National Space Society, the World Future Society, and MENSA, Sky Alert!: When Satellites Fail, p. 105

Resource Location

Looking for rare minerals to be mined for our many gadgets, household appliances, and industrial machines? Soil type is often a strong indicator of whether or not underground deposits of metals and minerals are located. By using satellite data to identify promising surface structural features and different soil types, mining companies can better identify promising mining locations, wasting less time and effort in finding the best places to obtain much-needed industrial resources. Without satellite images, the finding and assessment of promising new mines would grind to a halt as the industries retooled back into the days of much slower and labor-intensive field surveys (but without GPS!).

#### Amazon mining will cause extinction

Charito Ushiñahua 11, Anthropologist Working for the Preservation of Indigenous Amazonian Cultures, “Yanomami Indians: The Fierce People?”, http://www.amazon-indians.org/yanomami.html

A mineralogical survey of the northern Amazon by the Brazilian government in 1975 revealed the presence of gold ore in the Roraima region of Brazil. By the early 1980's, miners in search of gold began invading the Yanomami territory in Brazil and by 1987 it had become a full-fledged gold rush. Over 30,000 prospectors entered Yanomami lands and established over a hundred clandestine mining operations. The resulting massacres and diseases brought by these invaders is estimated to have caused the death of over 2,000 Yanomami. One of the problems with gold mining is the environmental destruction it causes. In order to separate gold from rocks and soil, mercury is used. Mercury in the rivers and streams bio-accumulates and permeates the entire ecosystem. The mercury accumulates in predators and hunters (such as the Yanomami) higher up the food chain and creates a neurotoxin that causes birth defects and abnormal child development. The Yanomami have had increased child mortality rates while their birth rates have declined putting their very existence into risk. Moreover, malaria increased in the area due to the stagnant pools left by the miners that increase the mosquito populations that are vectors of the disease. Some have estimated that malaria is responsible for the deaths of about 13% of the Yanomami population every year. However, the negative influence of the miners extends beyond physical health. Their introduction of alcohol and other western goods has had an immense negative effect on Yanomami society itself.

In response to the crisis created by the gold miners, in 1992 the Yanomami territory was protected by the Brazilian government by creating a federal indigenous reserve. However, the gold miners were not happy about the creation of the reserve and in July, 1993, a group of miners tried to exterminate an entire village in what has become to be known as the "Haximu Massacre." At lease 16 Yanomami were killed in what many have called genocide. Some of the miners were tried and convicted and after numerous appeals on the 7th of August, 2006 the Brazilian Supreme Federal Court reaffirmed that the crime known as the Haximu Massacre and upheld the ruling sentencing the miners to 19 years in prison for genocide. However, to this day there is political pressure by the mining industry to reduce the Yanomami territory and allow commercial mining operations on their lands.

In the year 2000, a journalist named Patrick Tierney published a book called, "Darkness in El Dorado," and accused anthropologist Napoleon Chagnon and his colleague geneticist James Neel of numerous misdeeds, among them intentionally creating an epidemic of measles among the Yanomami people in order to study the effects of natural selection on primitive societies. Tierney states that the resulting epidemic caused the death of hundreds of Yanomami. Incredibly, Tierney charged that the experiments were funded by the US Atomic Energy Commission, who sought to model the societal consequences of mass mortality caused by nuclear war. In addition to the measles epidemic, Tierney charged that Chagnon mischaracterized the Yanomami as "The Fierce People" when in fact it was Chagnon who was causing the violence by introducing enormous amounts of western goods such as machetes into the Yanomami society, thus stimulating warfare over the introduced goods. Tierney also accused Chagnon of fraud by staging films, such as "The Axe Fight" that he helped produce. The journalist charged that the anthropologist prescripted the films and that they were not spontaneous as portrayed.

Tierney's book caused an uproar in the anthropological community and the American Anthropological Association (AAA) got involved in the debate. In fact, the AAA convened a special commission to investigate the allegations against Chagnon and Neel. The report by the AAA issued in May, 2002 exonerated the anthropologist and geneticist from causing a measles epidemic among the Yanomami. Nonetheless, the AAA criticized some aspects of Chagnon's research, including his portrayal of the Yanomami as "The Fierce People," and his bribing of Venezuelan officials. However, the AAA debate was not over and three years later in June, 2005 they rescinded the acceptance of the 2002 report.

As someone who is working to support indigenous people, I would like to point out that over the many years since publishing his first book on the Yanomami (whose revenues made him a millionaire), Chagnon has failed to bring significant aid to the Yanomami people. In fact, he sought to damage the indigenous movement by publicly criticizing Davi Kopenawa, a Yanomami activist who helped establish the Yanomami reserve in Brazil. One might ask if it was proper behavior for an anthropologist to hurt the efforts of an indigenous Amazonian activist attempting to defend his people. Interestingly, the Yanomami leader Davi Kopenawa has predicted the destruction of the entire human race if the Amazon Rainforest is destroyed. Kopenawa states, "The forest-land will only die if it is destroyed by whites. Then, the creeks will disappear, the land will crumble, the trees will dry and the stones of the mountains will shatter under the heat. The xapiripë spirits who live in the mountain ranges and play in the forest will eventually flee. Their fathers, the shamans, will not be able to summon them to protect us. The forest-land will become dry and empty. The shamans will no longer be able to deter the smoke-epidemics and the malefic beings who make us ill. And so everyone will die." Many ecologists seem to agree with Kopenawa, believing that the Amazon Rainforest are the "lungs of the Earth" and that if the Amazon is destroyed, it will cause a global ecological disaster resulting in the eventual destruction of the human race.

#### Antarctic mining causes conflict---goes nuclear

David W. Floren 1, J.D. from the University of Oregon, “Antarctic Mining Regimes: An Appreciation of the Attainable”, Journal of Environmental Law and Litigation, Fall, Volume 16, Number 2, 467-513

Concern for the quality of the environment provides a great reason for a mining moratorium, but additional justifications exist. Critics of CRAMRA worry about Antarctica becoming a "scene [or] object of international discord." n221 Largely ignored in the ATS debate is the real danger an introduction of mining and fossil fuel facilities and infrastructure would pose to the integrity of the peacekeeping goals of the ATS. n222 Such facilities and their transportation mechanisms (pipelines, tankers, etc.) will be important targets for destruction or seizure during any armed conflict involving any nation reliant on Antarctic mineral and fossil fuel resources. Article I bans, "inter alia, any measures of a military nature, such as the establishment of military bases and fortifications, the carrying out of military maneuvers, as well as the testing of any type of weapons." n223 Although mining qua mining is clearly not military in nature, the simple existence of mining facilities necessarily entails certain consequences. The history of armed conflict shows the increasingly vital role played by mineral and energy resource facilities in sustaining wartime economies. n224 Such facilities have always been selected as priority targets in military planning and strategy sessions, and the absence of major civilian targets in Antarctica further emphasizes the focus on mining facilityes. Target status is inseparable from the existence of productive mining and fossil fuel facilities, n225 and target priority grows with [\*504] distance from large human population centers. n226 Compounding this problem is the possibility that nuclear weapons might be used. The remoteness and inaccessibility of targets in the AT Area, n227 combined with the tiny number of anticipated human casualties boosts the likelihood that tactical nuclear weaponry would be engaged to achieve top military priorities, despite AT obligations n228 and other international accords discouraging their use. n229

### Environmental Monitoring---1NC

#### Satellite monitoring fails and alternatives fill-in

Dr. Balázs M. Fekete 15, Professor in the Graduate School of Engineering at the City College of New York, PhD from the University of New Hampshire, MSc from the Budapest University of Technology and Economics, et al., “Time For In Situ Renaissance”, Science, August 2015, p. 686

FIDELITY, RESOLUTION, CONSISTENCY. Only in situ sensors, typically in close contact with the monitored medium, can measure a host of water-related quantity and quality parameters and processes ( 6) with reliable accuracy and sufficient frequency. Remote sensing provides indirect measurements normally limited to the near surface of the monitored object and affected by the media between the sensors and the monitored object. Remote-sensing observations are often the result of complex retrieval algorithms. In extreme cases, like satellite-derived evapotranspiration ( 7– 9), the algorithm is almost indistinguishable from land surface hydrology models, such that it is questionable that this qualifies as “observation.”

In situ observations are better suited for gradually changing observational targets, when strategically placed point measurement sensors are representative for larger areas. River discharge in particular is an ideal target for point monitoring because discharge only changes gradually along a river channel (except for confluences) and represents an integrated signal of the hydrological processes from a larger area upstream (1). Unless measurement requires laboratory processing of samples, in situ monitoring can provide observations at high temporal frequency. Many in situ observational records cover multiple decades of continuous data at high temporal resolution. Observation consistency depends on continuous instrument maintenance and recalibration that is often the most expensive part of the monitoring program. Remote sensing that only replaces relatively inexpensive measurements without comparably rigorous calibration will compromise monitoring ( 5).

Satellites are placed either in geostationary orbit, where they can provide continuous observations at low spatial resolution, or in low Earth orbits, which results in low repeat frequencies flying over the same area unless a constellation of satellites is deployed at added expense. It can be difficult to derive continuous (multidecadal) time series from satellite records, because technology changes and space agencies do not pay adequate attention to the homogeneity of observational records. Many satellite platforms (with the exception of meteorological satellites in geostationary orbits) are still in an “experimental” phase without long-term commitment for continued operations. Satellite sensors without adequate backup present a single point of failure leading to abrupt termination of observations.

COST, INNOVATION, ACCESS. Cost comparison of satellite remote sensing versus in situ monitoring is difficult because the final products are rarely comparable. Satellite remote sensing only competes in large-scale or global applications, because it cannot replace in situ monitoring in most cases. Cost comparison should be posed as the additional expense of extending existing in situ monitoring, including incentives for data sharing and aggregating observations, versus operating an independent satellite monitoring infrastructure. A recent World Bank report ( 10) estimated that $1.5 to $2 billion would be necessary to modernize developing countries’ hydrometeorological monitoring infrastructure and an additional $0.4 to $0.5 billion annually for maintenance. These are comparable to the typical $0.3 to $0.6 billion price tag of medium-sized satellite missions.

Telecommunication breakthroughs and their widespread use lower barriers to data transmission. New sensor and deployment technologies are improving performance and cost. Autonomous drone vehicles (aircraft, boats, or submarines) could operate as monitoring platforms, which would blur the distinction between remote sensing and in situ observations. Solar unmanned aerial vehicles may offer cost-effective alternatives to satellites.

#### Budget cuts thump

Matt Daniel 12, Meteorologist for 13WMAZ (CBS), Founder of the Blog Athens GA Weather, Produced Weather Content for CNN, MSN Weather and EarthSky, “Rapid Decline in U.S. Satellites Could Be Costly”, EarthSky, 5/7/2012, https://earthsky.org/earth/rapid-decline-in-u-s-satellites-could-be-costly

Satellites allow us to monitor the Earth in a way that we today might take for granted. Yet the latest report from the National Research Council, released on April 2, 2012 suggests the number and capability of weather satellites are beginning to hit a steep decline. The number of orbiting satellites from NASA and NOAA is expected to drop significantly from 23 this year to only six by 2020, given today’s budget figures. Overall, the projected number of satellites that monitor Earth’s activity is expected to decline from a peak of 110 last year to fewer than 30 by the end of the decade.

The main reason for the possible decline in the use of Earth-orbiting satellites over the next 10 years is, of course, money. Less money is going into NASA and NOAA’s satellite programs, and tight budgets are pushing back or eliminating missions to replace older satellites. Satellites are extremely expensive to launch and to maintain. Like any machine, they undergo wear and tear over the years, and typically have to be replaced. Sometimes, although rarely, solar flares from storms on the sun can be so strong as to completely disrupt or cause a malfunction in a satellite orbiting Earth. What will happen if this does occur?

Consider the use of Earth-orbiting satellites in studying the global weather and climate. Without them, all of our advancements in meteorology in the past 40 to 50 years – including advancements in tornado and hurricane tracking, for example, or the work to understand climate change – would never have taken place. Advanced warnings of tropical systems would be nonexistent without satellites, and it would have likely brought more death and destruction to areas hit hard by cyclones. (Camille-1969, Andrew-1992, and Katrina-2005) NASA also uses several satellites now in orbit to measure other very specific atmospheric phenomena, such as the amount of ozone in the atmosphere, and to try to distinguish between environmental changes caused by humans and those that occur naturally.

#### No environmental collapse or extinction

Peter Kareiva 18 and Valerie Carranza, Institute of the Environment and Sustainability, University of California, Los Angeles, “Existential Risk Due To Ecosystem Collapse: Nature Strikes Back,” Futures, 1/5/2018, ScienceDirect

The interesting question is whether any of the planetary thresholds other than CO2 could also portend existential risks. Here the answer is not clear. One boundary often mentioned as a concern for the fate of global civilization is biodiversity (Ehrlich & Ehrlich, 2012), with the proposed safety threshold being a loss of greater than 0.001% per year (Rockström et al., 2009). There is little evidence that this particular 0.001% annual loss is a threshold—and it is hard to imagine any data that would allow one to identify where the threshold was (Brook, Ellis, Perring, Mackay, & Blomqvist, 2013; Lenton & Williams, 2013). A better question is whether one can imagine any scenario by which the loss of too many species leads to the collapse of societies and environmental disasters, even though one cannot know the absolute number of extinctions that would be required to create this dystopia. While there are data that relate local reductions in species richness to altered ecosystem function, these results do not point to substantial existential risks. The data are small-scale experiments in which plant productivity, or nutrient retention is reduced as species numbers decline locally (Vellend, 2017), or are local observations of increased variability in fisheries yield when stock diversity is lost (Schindler et al., 2010). Those are not existential risks. To make the link even more tenuous, there is little evidence that biodiversity is even declining at local scales (Vellend et al., 2013, 2017). Total planetary biodiversity may be in decline, but local and regional biodiversity is often staying the same because species from elsewhere replace local losses, albeit homogenizing the world in the process. Although the majority of conservation scientists are likely to flinch at this conclusion, there is growing skepticism regarding the strength of evidence linking trends in biodiversity loss to an existential risk for humans (Maier, 2012; Vellend, 2014). Obviously if all biodiversity disappeared civilization would end—but no one is forecasting the loss of all species. It seems plausible that the loss of 90% of the world’s species could also be apocalyptic, but not one is predicting that degree of biodiversity loss either. Tragic, but plausible is the possibility of our planet suffering a loss of as many as half of its species. If global biodiversity were halved, but at the same time locally the number of species stayed relatively stable, what would be the mechanism for an end-of-civilization or even end of human prosperity scenario? Extinctions and biodiversity loss are ethical and spiritual losses, but perhaps not an existential risk.

### Grid

#### Humans will survive without satellites

Dr. Jim Wild 15, Professor of Space Physics at Lancaster University, Vice-President (Geophysics) of the Royal Astronomical Society, “With So Much Vested In Satellites, Solar Storms Could Bring Life To A Standstill”, The Conversation, 7/30/2015, https://theconversation.com/with-so-much-vested-in-satellites-solar-storms-could-bring-life-to-a-standstill-45204

Satellites are essential to modern life. So essential, in fact, that plans have been drawn up on how to cope with a situation in which we could no longer rely on them. A UK government document entitled the Space Weather Preparedness Strategy may sound strange, but when so much of modern communications, transport and the financial system relies on satellites, you can imagine why one would want a Plan B in place.

The reality is that we depend on satellites in more ways than we realise. The concept was popularised in a 1945 letter to Wireless World written by science fiction writer and inventor Arthur C Clarke – and from then satellite services has grown into an industry worth US$100 billion a year.

This highlights the extent to which satellite services pervade modern life. A fleet of several hundred communications satellites encircles our planet in geosynchronous Earth-orbit, with hundreds more at lower altitudes. Rapid satellite communications enable the global markets underpinning our economy, and the emergency and defence services that keep society safe. Satellites provide GPS global navigation services for transport on land, sea and in the air. Modern agriculture, manufacturing and logistics chains, that supply virtually everything you consume – from the milk in your coffee to the screen you’re reading this on – rely on information provided by satellites.

But you’d be forgiven for never noticing some of the subtle influences of satellite technology on your life. After all, who’d have thought that some trains use GPS data to control which doors open at platforms of different lengths? Or that banks uses high-precision timing of satellite navigation systems to time-stamp its financial transactions?

Worst case scenario

We could survive without satellites, but their influence and benefits are so widespread that it would require concerted effort and massive investment to do so. Which has led some to consider the risks satellites face, and what to do about them.

#### Alternatives solve---it’d just make life slightly harder

Bob Hannent 17, BSc (Hons) Media Technology, Southampton Solent University, Technologist and Video Architect, “Can We Make It Without Satellites?”, Quora, 6/29/2017, https://www.quora.com/Can-we-make-it-without-satellites

Can we make it without satellites?

Yes, although it would make life slightly harder.

Weather forecasting relies on satellites these days.

Remote high speed communications from

Ships at sea often use satellites for weather reports, communications and entertainment

Remote oil rigs or processing stations in remote areas use them for communication and entertainment

Islands without fiber optic links such as many Pacific islands

Navigation of ships and aircraft using GPS/GNSS

All pilots and ships are supposed to be able to navigate without GPS

Without satellite communications many communities and groups would be isolated. They would probably be dependent on very slow HF communications or relatively slow and expensive VHF relays.

Navigation on land can be done with ground station beacon navigation perhaps using cell towers and TV/radio transmitters. Navigation at sea near to shore can use the same beacons and longer range ones can give more coverage. Deep sea? You could use some kind of long range positioning or even astronavigation with some compute power and clear skies.

### At water

#### Water war inevitable: war card states that these countries each have a claim to a river, drought forecasting from satellites can’t stop war for river.

### Solar Storms---1NC

#### Massive solar storms are coming soon and will wipe out satellites

Sebastian Kettley 19, Science Reporter at the Daily Express, BA in Journalism from Goldsmiths College, University of London, Former News Editor at The Leopard, Editor at Vivium Intelligent Media, “Solar Storm Warning: Devastating Space Weather Could Hit Earth By 2020 - NASA Warns”, The Daily Express, 1/29/2019, https://www.express.co.uk/news/science/1079584/Solar-storm-warning-space-weather-Nasa-solar-flare-Earth-2020-geomagnetic-storm

Powerful solar storms ejected from holes in the surface of the Sun could wreak havoc across Earth as early as 2020, NASA has warned.

The Sun will undergo a period of solar minimum between 2019 and 2020, and with it comes the increased risk of solar storms. Every 11 to 12 years or so, the Sun enters a phase of solar maximum and is followed by a solar minimum. The transition from one state to another is marked by a lower number of solar flares and sunspots erupting on the surface of the Sun. But this does not mean activity at the burning heart of the solar system subsides or weakens.

Instead, solar minimums give way to Coronal Mass Ejections (CMEs) ripping holes through the Sun’s magnetosphere.

These gaping tears in the Sun’s outer layer release vast amounts of charged particles and radiation out into space and towards the Earth.

CMEs often create the conditions for heightened geomagnetic activity and aurora lights around our home world.

This can knock communications satellites out of order and trigger widespread power blackouts.

And according to Dean Pesnell of NASA's Goddard Space Flight Center, this is a natural part of the Sun’s cycle.

The space expert said: “We see these holes throughout the solar cycle but during solar minimum they can last for a long time – six months or more.”

Streams of charged solar winds escaping from the Sun have the power to cause a wide array of disastrous effects around the planet.

Some of the weakest solar storms have been known to confuse migratory animals while stronger ones might cause GPS systems to fail.

Solar storms can wipe out satellites, disable communications and render Earth’s navigations systems useless.

The US Space Weather Prediction Center (SWPC) explained: “While the storms create beautiful aurora, they also can disrupt navigation systems such as the Global Navigation Satellite System and create harmful geomagnetic induced currents in the power grid and pipelines.”

Just this week, on Monday, January 28, space weather forecasters have warned a coronal hole had opened in the Sun and is facing the Earth.

Forecasters at SpaceWeatherLive warned “enhanced solar winds” are now barreling towards the planet in as little as three days.

## Nr

#### Amazon outweighs:

#### Magnitude---loss ends life on earth---pollution from mining bio-accumulates, destroying the entire ecosystem---that takes out the Lungs of the Earth, killing everything

#### Extinction from oxygen

Dr. Richard Witzig 6, Infectious Disease Specialist, Founder of Social Vaccine Strategies, The Global Art of Soccer, p. 339

The Amazon basin is often correctly labeled the "Lung of the World" ("I'ulmon del Mundo"), as it provides more vital oxygen per square kilometer than any other land mass in the world. However, the targeting of the mass destruction of much of the Amazon by weak governments and avaricious logging mid oil companies is threatening not only the environment, but many forms of life on earth. Without the preservation of the miraculous Amazon rainforest biodiversity and oxygen generation, mammals and eventually humans will be at increased risk of species extinction (see www earthrcnewal.org/rainless.htm).

#### It sparks nuclear wars

David Takacs 96, Institute for Earth Systems Science and Policy at California State University, Monterey Bay, The Idea Of Diversity: Philosophies Of Paradise, p. 200-201

So biodiversity keeps the world running. It has value and of itself, as well as for us. Raven, Erwin, and Wilson oblige us to think about the value of biodiversity for our own lives. The Ehrlichs’ rivet-popper trope makes this same point; by eliminating rivets, we play Russian roulette with global ecology and human futures: “It is likely that destruction of the rich complex of species in the Amazon basin could trigger rapid changes in global climate patterns. Agriculture remains heavily dependent on stable climate, and human beings remain heavily dependent on food. By the end of the century the extinction of perhaps a million species in the Amazon basin could have entrained famines in which a billion human beings perished. And if our species is very unlucky, the famines could lead to a thermonuclear war, which could extinguish civilization.” Elsewhere Ehrlich uses different particulars with no less drama: What then will happen if the current decimation of organic diversity continues? Crop yields will be more difficult to maintain in the face of climatic change, soil erosion, loss of dependable water supplies, decline of pollinators, and ever more serious assaults by pests. Conversion of productive land to wasteland will accelerate; deserts will continue their seemingly inexorable expansion. Air pollution will increase, and local climates will become harsher. Humanity will have to forgo many of the direct economic benefits it might have withdrawn from Earth's well­stocked genetic library. It might, for example, miss out on a cure for cancer; but that will make little difference. As ecosystem services falter, mortality from respiratory and epidemic disease, natural disasters, and especially famine will lower life expectancies to the point where can­cer (largely a disease of the elderly) will be unimportant. Humanity will bring upon itself consequences depressingly similar to those expected from a nuclear winter. Barring a nuclear conflict, it appears that civilization will disappear some time before the end of the next century - not with a bang but a whimper.

#### Amazon destruction causes disease spread and global economic collapse

Robert S. Chase 96, PhD Candidate in Economics at Yale University, et al., Foreign Affairs, Jan/Feb, Lexis

The array of plants and trees in the Amazon is an important source of natural pharmaceuticals; deforestation may also spread diseases as the natural hosts of viruses and bacteria are displaced to other regions. A social and political collapse would directly affect significant U.S. economic interests and American investors. Brazil's fate is inextricably linked to that of the entire South American region, a region that before its debt and inflation crises in the 1970s bought large amounts of U.S. goods and is now potentially the fastest-growing market for American business over the decades to come. In sum, were Brazil to succeed in stabilizing over the long term, reducing the massive gap between its rich and poor, further opening its markets, and privatizing often inefficient state-run industries, it could be a powerful engine for the regional economy and a stimulus to U.S. prosperity. Were it to fail, Americans would feel the consequences.