**Framing**

**Pleasure and pain are intrinsically valuable.**

Moen 16 [(Ole Martin Moen, Research Fellow in Philosophy at University of Oslo) “An Argument for Hedonism,” Journal of Value Inquiry (Springer), 50 (2) 2016: 267–281,<https://link.springer.com/article/10.1007/s10790-015-9506-9>] TDI

Let us start by observing, empirically, that **a widely shared judgment about intrinsic value and disvalue is that pleasure is intrinsically valuable and pain is intrinsically disvaluable.** **On virtually any proposed list of intrinsic values and disvalues (we will look at some of them below), pleasure is included among the intrinsic values and pain among the intrinsic disvalues.** This inclusion makes intuitive sense, moreover, for **there is something undeniably good about the way pleasure feels and something undeniably bad about the way pain feels, and neither the goodness of pleasure nor the badness of pain seems to be exhausted by the further effects that these experiences might have.** “Pleasure” and “pain” are here understood inclusively, as encompassing anything hedonically positive and anything hedonically negative.2 **The special value statuses of pleasure and pain are manifested in how we treat these experiences in our everyday reasoning about values.** If you tell me that you are heading for the convenience store, **I might ask: “What for?” This is a reasonable question, for when you go to the convenience store you usually do so**, not merely for the sake of going to the convenience store, but **for the sake of achieving something further that you deem to be valuable.** You might answer, for example: “To buy soda.” This answer makes sense, for soda is a nice thing and you can get it at the convenience store. I might further inquire, however: “What is buying the soda good for?” This further question can also be a reasonable one, for it need not be obvious why you want the soda. You might answer: “Well, I want it for the pleasure of drinking it.” **If I then proceed by asking “But what is the pleasure of drinking the soda good for?” the discussion is likely to reach an awkward end. The reason is that the pleasure is not good for anything further; it is simply that for which going to the convenience store and buying the soda is good.**3 As Aristotle observes**: “We never ask [a man] what his end is in being pleased, because we assume that pleasure is choice worthy in itself.**”4 Presumably, a similar story can be told in the case of pains, for if someone says “This is painful!” we never respond by asking: “And why is that a problem?” We take for granted that if something is painful, we have a sufficient explanation of why it is bad. If we are onto something in our everyday reasoning about values, it seems that **pleasure and pain are both places where we reach the end of the line in matters of value.**

**Moral uncertainty means preventing extinction should be our highest priority.**

Bostrom 12 [(Nick Bostrom, Faculty of Philosophy & Oxford Martin School University of Oxford) “Existential Risk Prevention as Global Priority.” Global Policy, 2012] TDI

These reflections on moral uncertainty suggest an alternative, complementary way of looking at existential risk; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate.¶ Our present understanding of axiology might well be confused. We may not now know — at least not in concrete detail — what outcomes would count as a big win for humanity; we might not even yet be able to imagine the best ends of our journey. If we are indeed profoundly uncertain about our ultimate aims, then we should recognize that there is a great option value in preserving — and ideally improving — our ability to recognize value and to steer the future accordingly. Ensuring that there will be a future version of humanity with great powers and a propensity to use them wisely is plausibly the best way available to us to increase the probability that the future will contain a lot of value. To do this, we must prevent any existential catastrophe.

**1AC – Advantage**

**The advantage is space exploration.**

**It solves a litany of existential threats.**

**Fitzgerald 3/9** [(Shanon, Assistant Websites Editor at Liberty Fund), “Why Human Space Exploration Matters,” March 9 2021, https://www.econlib.org/why-human-space-exploration-matters/] TDI

While the yields to space exploration and the development of spaceflight technology may appear minimal in the immediate future, shifting our perspective to the longer term renders the human situation vis a viz space exploration extremely clear: if humans want to survive in perpetuity, we need to establish ourselves on other planets in addition to Earth. It is as simple as that. And yet we are not doing all that much to make that happen. To be clear, I’m long on Earth, too, and hope that technological improvements will continue to allow our species to get “more from less” right here on the third rock from the sun, enabling us to keep occupying the planet that saw us evolve into consciousness. I like to imagine that the distant future on Earth has the potential to be an extremely pleasant one, as advances in our scientific understanding and bio-technical praxis should hopefully allow our descendants to clean up any of the remaining messes previous generations will have left behind (e.g., nuclear and industrial waste, high amounts of atmospheric carbon, other lingering nasties) and stable-state free societies will hopefully allow all persons (or very nearly all persons) to live free and meaningful lives in productive community and exchange with their fellows. As the previous qualification highlights, the trickiest problems here on Earth and extending to wherever humans end up in the spacefaring age will still be social and political, and their successful resolution will depend more on the future state of our governing arts than our hard sciences. But regarding the negative events that could very well happen to Earth I think we all need to be equally clear: life might not make it here. There is no guarantee that it will, and in the very long run, with the expansion and subsequent death of our sun, we know with near certainty that it will not. Consider just a few possible extinction-level events that could strike even earlier: large meteors, supervolcanic eruptions, drastic climactic disruption of the “Snowball Earth” variety. As SpaceX founder and Tesla CEO Elon Musk recently observed on the Joe Rogan Experience podcast, “A species that does not become multiplanetary is simply waiting around until there is some extinction event, either self-inflicted or external.” This statement, applied to the human species, is obviously true on its face. As doomsday events go a giant asteroid might be more shocking, since we (people living today) have never experienced one before while concerned atomic scientists warn us about the nuclear bomb all the time, but the odds that we blow ourselves up are still there. Slim, but there. It’s more plausible that a severe nuclear war and the nuclear winter it would likely trigger would leave the human population greatly reduced as opposed to completely extinct, but then the question becomes: why is that a risk we would want to take? The bomb is here to stay for now, but there is no reason that 100% of known life in the universe needs to stay here on Earth to keep it company, waiting around for something even more destructive to show up. While we’re on that happy subject: Do you have any good intuitions about our collective chances against hostile, or simply arrogant or domineering, technologically-advanced extraterrestrial lifeforms, if and/or when they decide to pay us a visit on our home turf? These scary situation sketches will suffice. At bottom, the core reason I am a believer in the need to make life—and not just human life—multiplanetary is the same basic reason I would never counsel a friend to keep all their money and valuables in one place: diversification is good. Wisdom and experience suggest we store precious resources in multiple safe(ish) places. Diversification limits our exposure to risk, and increases our resilience when bad things do happen. One reserve gets hit, two or three others survive, and you probably feel that the effort to spread things out was worth it. What I’m saying here has strong undercurrents of common sense, yet our approach to the human population itself—the universal store and font of “human capital”—does not currently prioritize diversification to the degree our technological capabilities would allow. The distribution of the human population, and of almost all human knowledge and works, is overwhelmingly local. (Let us set to one side the possibility that aliens somewhere maintain an archive of captured human information.) Establishing outposts at least as large as those we maintain in Antarctica on the Moon and Mars, or other more suitable sites, by the end of this century would be a great first step toward genuinely diversifying the physical locations of the most precious resources known to us: human consciousness and creativity, human love and human soul, the great works in which all these things are displayed. Add also to this list repositories of scientific knowledge and knowhow, seed reserves, and certain materials necessary to re-start the manufacturing of fundamental technologies. Spreading these goods to a few additional locations within the solar system would be a major species-and-civilization-level accomplishment that all living at the time could feel satisfied by, and even take some pride in. And this is something that we seem to be just on the cusp of being able to do, given our recent and rapid technological advances in rocketry, computers, and materials science and engineering, among other important fields for space exploration and settlement. Quickly the uniplanetary human situation is becoming, if it is not already, one of pure choice.

**Second, Russia—**

**Deep space exploration is a shared goal that prevents escalation of US-Russia tensions. But privatization threatens it independent of our other internal links**

**CSIS 18** [(Center for Strategic and International Studies), “Why Human Space Exploration Matters,” August 21, 2018 https://www.csis.org/blogs/post-soviet-post/space-cooperation] TDI

U.S.-Russian space cooperation continues to be a stated mutual goal. In April 2018, President Putin said of space, “Thank God, this field of activity is not being influenced by problems in politics. Therefore, I hope that everything will develop, since it is in the interests of everyone…This is a sphere that unites people. I hope it will continue to be this way.” During his statement at a recent event at CSIS, NASA Administrator Jim Bridenstine said, **“[space] is our best opportunity to dialogue when everything else falls apart.** We’ve got American astronauts and Russian cosmonauts dependent on each other on the International Space Station, which enables us to ultimately maintain that dialogue.” The U.S. and Russia both benefit from the ISS partnership. Russia provides transportation to the ISS for U.S. astronauts, from which Russia receives an average of $81 million per seat on the Soyuz (and recognition of its status as a space power). The U.S. also benefits from Russia’s technical contributions to the ISS while Russia benefits **The U.S. and Russia** signed a joint statement in 2017 in **support** of **the idea of collaborating on deep space exploration**, including the construction of the Lunar Orbital Platform-Gateway, a research-focused space station orbiting the moon. Through agreements on civilian space exploration, such as the Lunar Orbital Platform-Gateway or future Mars projects, that have clear benefits to both sides, some degree of cooperation will remain in both countries’ interest. The high price tag for pursuing space exploration alone and opportunities for sharing and receiving technical expertise encourages international partnerships like the ISS. However, at least three factors, apart from the overall deterioration of U.S.-Russia relations, threaten this cooperation. First, **growth of the private sector space industry may alter the economic arrangement between the U.S. and Russia,** and ultimately **lower the benefits of cooperation to both** countries. The development of advanced technologies by private companies will give NASA new options to choose from and reduce the need to depend on (and negotiate with) Russia. **If NASA and its Russian counterpart, Roskosmos, have no need to talk with one another, they probably won’t in the face of tense political relations.** The U.S. intends to use Boeing and SpaceX capsules for human spaceflight beginning in 2020, and a Congressional plan in 2016 set a phase out date of Russian RD-180 rocket engines by 2022.

**It’s make or break for the relationship—Ukraine, decline of US authority on international affairs puts us at the brink of the end of Russian diplomacy and even war**

**Weir 21** [(Fred Weir has been the Monitor's Moscow correspondent, covering Russia and the former Soviet Union, since 1998. He's traveled over much of that vast territory, reporting on stories ranging from Russia's financial crash to the war in Chechnya, creeping Islamization in central Asia, Russia's demographic crisis, the rise of Vladimir Putin and his repeated returns to the Kremlin, and the ups and downs of US-Russia relations). “Worse than the Cold War? US-Russia relations hit new low.“ Christian Science Monitor 4-20-2021 https://www.csmonitor.com/World/Europe/2021/0420/Worse-than-the-Cold-War-US-Russia-relations-hit-new-low] TDI

Russia’s relations with the West, and the United States in particular, appear to be plumbing depths of acrimony and mutual misunderstanding unseen even during the original Cold War.After years of deteriorating relations, sanctions, tit-for-tat diplomatic expulsions, and an escalating “information war,” some in Moscow are asking if there even is any point in seeking renewed dialogue with the U.S., if only out of concern that more talking might just make things worse. Events have cascaded over the past month. Russia’s treatment of imprisoned dissident Alexei Navalny, who has been sent to a prison hospital amid reports of failing health, underlines the sharp perceived differences between Russia and the West over matters of human rights. Meanwhile, a Russian military buildup near Ukraine has illustrated that the conflict in the Donbass region might explode at any time, possibly even dragging Russia and NATO into direct confrontation. With its relations with Washington at a nadir, Russia is eyeing a more pragmatic, if adversarial, relationship with the U.S. in the hopes of getting the respect it desires. President Joe Biden surprised the Kremlin by proposing a “personal summit” to discuss the growing list of U.S.-Russia disagreements in a phone conversation with Vladimir Putin last week. He later spoke of the need for “disengagement” in the escalating tensions around Ukraine, and postponed a planned visit of two U.S. warships to Russia-adjacent waters in the Black Sea. But days later he also imposed a package of tough sanctions against Russia, for its alleged SolarWinds hacking and interference in the 2020 U.S. presidential elections, infuriating Moscow and drawing threats of retaliation. Last month, after Mr. Biden agreed with a journalist’s intimation that Mr. Putin is a “killer,” the Kremlin ordered Russia’s ambassador to the U.S. to return home for intensive consultations, an almost unprecedented peacetime move. Over the weekend, Russian Foreign Minister Sergey Lavrov suggested that the acting U.S. ambassador to Moscow, John Sullivan, should likewise go back to Washington for a spell. On Tuesday, Mr. Sullivan announced he would do just that this week. And there is a growing sense in Moscow that the downward spiral of East-West ties has reached a point of no return, and that Russia should consider abandoning hopes of reconciliation with the West and seek permanent alternatives: perhaps in an intensified compact with China, and targeted relationships with countries of Europe and other regions that are willing to do business with Moscow. **“Things are at rock bottom.** This may not be structurally a cold war in the way the old one was, but mentally, in terms of atmosphere, it’s even worse,” says Fyodor Lukyanov, editor of Russia in Global Affairs, a Moscow-based foreign policy journal. “The fact that Biden offered a summit meeting would have sounded a hopeful note anytime in the past. Now, nobody can be sure of that. A hypothetical Putin-Biden meeting might not prove to be a path to better relations, but just the opposite. It could just become a shouting match that would bring a hardening of differences, and make relations look like even more of a dead end.” Room for discussion Foreign policy experts agree that there is a long list of practical issues that could benefit from purposeful high-level discussion. With the U.S. preparing to finally exit Afghanistan, some coordination with regional countries, including Russia and its Central Asian allies, might make the transition easier for everyone. One of Mr. Biden’s first acts in office was to extend the New START arms control agreement, which the Trump administration had been threatening to abandon, but the former paradigm of strategic stability remains in tatters and requires urgent attention, experts say. “If you are looking for opportunities to make the world a safer place through reason and compromise, there are quite a few,” says Andrey Kortunov, director of the Russian International Affairs Council, which is affiliated with the Foreign Ministry. “There are also some areas where the best we could do is agree to disagree, such as Ukraine and human rights issues.” The plight of Mr. Navalny, which has evoked so much outrage in the West, seems unlikely to provide leverage in dealing with the Kremlin because – as Western moral authority fades – Russian public opinion appears indifferent, or even in agreement with its government’s actions. Recent surveys by the Levada Center in Moscow, Russia’s only independent pollster, found that fewer than a fifth of Russians approve of Mr. Navalny’s activities, while well over half disapprove. An April poll found that while 29% of Russians consider Mr. Navalny’s imprisonment unfair, 48% think it is fair. Russian opposition figure Alexei Navalny, shown here during a hearing in the Babuskinsky District Court in Moscow Feb. 12, 2021, is in poor health amid his hunger strike while in prison in Russia. He was recently moved to a prison hospital. Tensions around the Russian-backed rebel republics in eastern Ukraine have been much severer than usual, with a spike in violent incidents on the front line, a demonstrative Russian military buildup near the borders, and strong U.S. and NATO affirmations of support for Kyiv. The Russian narrative claims that Ukrainian President Volodymyr Zelenskiy triggered the crisis a month ago by signing a decree that makes retaking the Russian-annexed territory of Crimea official Ukrainian state policy. Mr. Zelenskiy has also appealed to the U.S. and Europe to expedite Ukraine’s membership in NATO, which Russia has long described as **a “red line” that would lead to war.** But Russian leaders, who have been at pains to deny any direct involvement in Ukraine’s war for the past seven years, now say openly that they will fight to defend the two rebel republics. Top Kremlin official Dmitry Kozak even warned that if conflict erupts, it could be “the beginning of the end” for Ukraine. **“This is a very desperate situation**,” says Vadim Karasyov, director of the independent Institute of Global Strategies in Kyiv. “We know the West is not going to help Ukraine militarily if it comes to war. So we need to find some kind of workable compromises, not more pretexts for war.” Time to turn eastward? In this increasingly vexed atmosphere, the Russians appear to be saying there is no point in Mr. Putin and Mr. Biden meeting unless an agenda has been prepared well in advance, setting out a few achievable goals and leaving aside areas where there can be no agreement. “Russia isn’t going to take part in another circus like we had with Trump in Helsinki in 2018,” says Sergei Markedonov, an expert with MGIMO University in Moscow. “What is needed is a deeper dialogue. That could begin if we had a real old-fashioned summit between Biden and Putin, one that has been calculated to yield at least some positive results. We need to find a modus vivendi going forward, and the present course is not leading there.” Alternatively, Russia may turn away from any hopes of even pragmatic rapprochement with the West, experts warn. Mr. Lukyanov, who maintains close contact with his Chinese counterparts, says they felt blindsided at a summit with U.S. foreign policy chiefs in Alaska last month, when what they expected to be a practical discussion of how to overcome the acrimonious Trump-era legacy in their relations turned into what they saw as a U.S. lecture about how China needs to obey the “rules-based” international order. “It was the Chinese, in the past, who were very cautious about participating” in anything that looked like an anti-Western alliance, says Mr. Lukyanov. “**We are hearing a new tone from them now.** Now our growing relationship with China isn’t just about compensating for a lack of relations with the U.S. It’s about the need to build up a group of countries that will resist the U.S., aimed at containing U.S. activities and policies that are harmful to our two countries.”

**Space weapons heighten potential for escalation and make perceptions of US-Russia space conflict key.**

Alexey **Arbatov et al**, head of the Center for International Security at the Primakov National Research Institute of World Economy and International Relations, Major General Vladimir Dvorkin, a principal researcher at the Center for International Security at the Primakov National Research Institute of World Economy and International Relations and Peter Topychkanov, fellow at the Carnegie Moscow Center’s Nonproliferation Program, **‘17** “Russian And Chinese Perspectives On Non-Nuclear Weapons And Nuclear Risks” *Carnegie Endowment for International Peace Publications,*<https://www.russiamatters.org/sites/default/files/media/files/Entanglement_interior_FNL.pdf>

Against this background, Russian military and technical experts are currently engaged in efforts to elaborate strategies for fighting an air-space war. The following is an attempt to frame such an integrated doctrine by one of its main theoreticians, Colonel Yuri Krinitsky from the Military Air-Space Defense Academy: “The integration of aerial and space-based means of attack has transformed airspace and space into a specific field of armed conflict: an air-space theater of military operations. United, systematically organized actions of [U.S.] air-space power in this theater should be countered with united and systematically organized actions by the Russian Air-Space Defense Forces. This is required under the National Security Strategy of the Russian Federation and Air-Space Defense Plan approved by the Russian president in 2006.”6 This document goes on to list the tasks of the Air-Space Defense Forces as “monitoring and reconnaissance of the airspace situation; identifying the beginning of an aerial, missile, or space attack; informing state organs and the military leadership of the Russian Federation about it; repelling air-space attacks; and defending command sites of the top levels of state and military command authorities, strategic nuclear forces’ groupings, and the elements of missile warning systems.”7 While picking apart in detail the organizational, operational, and technical aspects of the Air-Space Defense Forces (now part of the Air-Space Forces),8 military analysts step around the basic question of what constitutes “the means of air-space attack” (SVKN in Russian, MASA in English). This term and “air-space attack” are broadly used in official documents (including the Military Doctrine) and statements, as well as in the new names of military organizations (such as the Air-Space Forces), and in a seemingly infinite number of professional articles, books, and pamphlets. If MASA refers to aircraft and cruise missiles, then what does space have to do with it? To be sure, various military communication and intelligence, reconnaissance, and surveillance satellites are based in space, but these assets also serve the Navy and Ground Forces without the word “space” tacked onto their names. If MASA refers to long-range ballistic missiles, which have trajectories that pass mostly through space, then this threat is not new but has existed for more than sixty years. There was—and still is—no defense against a massive ballistic missile strike, and none is likely in the future in spite of U.S. and Russian efforts at missile defense. In the past (and possibly now), one of the possible tasks of ballistic missiles was to break “corridors” in the enemy’s air-defense system to enable bombers to penetrate it. But with ballistic missiles being armed with more warheads with improved accuracy, and with the advent of longrange air-launched cruise missiles, it is increasingly unnecessary for bombers to be able to penetrate enemy air defenses. Coordination between air and notional “space” systems has apparently moved to the background of strategic planning. Anyway, this tactic was never considered as air-space warfare before now. MASA may be used in reference to potential hypersonic boost-glide weapons, which are discussed below. But their role and capabilities are not yet known, so it would clearly be premature to build the theory of air-space war on them, and even more so to start creating defenses against them. In any case, referring to those weapons as MASA is farfetched: besides a short boost phase, their entire trajectory is in the upper atmosphere at speeds greater than airplanes but lower than ballistic missiles. It is, therefore, even less apt to describe such systems as space arms than it is to refer to traditional long-range ballistic missiles as such. Finally, as for theoretically possible space-based weapons that would conduct strikes against targets on the ground, at sea, and in the air, they do not yet exist, and their future viability is far from clear. Even if the concept of air-space war is ill-defined, the military and technical experts who propound it reach a predictable conclusion with regard to the capabilities needed to fight one. They typically argue that Russia needs “to counter the air-space attack system with an air-space defense system. . . . A prospective system for destroying and suppressing MASA should be a synergy of anti-missile, anti-satellite, and air-defense missiles, and air units, and radio-electronic warfare forces. And its composition should be multilayered.”9 **Such calls are being translated into policy.** Most notably, the air-space defense program, for which the military’s top brass and industrial corporations lobbied, is the single largest component of the State Armaments Program through 2020, accounting for about 20 percent of all costs when the program was first announced in 2011—about 3.4 trillion rubles ($106 billion at the time).10 Along with the modernization of the missile early-warning system by the development and deployment of new Voronezh-type land-based radars and missile-launch detection satellites, the program envisages the deployment of twenty-eight missile regiments of S-400 Triumph air-defense systems (about 450 to 670 launchers), and thirty-eight battalions equipped with the next-generation S-500 Vityaz (recently renamed Prometey) systems (300 to 460 launchers).11 In total, the plan is to manufacture up to 3,000 missile interceptors of the two types, for which three new production plants were built. A new integrated and fully automatic command-and-control system is being created to facilitate operations by the Air-Space Defense Forces. The Moscow A-135 missile defense system (now renamed A-235) is being modernized with non-nuclear kinetic interceptors to engage incoming ballistic missiles (previously the interceptors were armed with nuclear warheads).12 The current Russian economic crisis, which has resulted in defense budget cuts in fiscal year 2017, may slow down the air-space armament programs and the scale of arms procurement, but the underlying momentum will be unaffected unless stopped or redirected by a major change in Russia’s defense posture. In a sense, Russian policy may be explained by the **visceral desire** of the military to break out from the deadlock—the “strangulating effect”—of mutual assured nuclear destruction, which has made further arms development, high-technology competition, and supposedly fascinating global war scenarios senseless (indeed, it prompted U.S. and Soviet leaders of the 1970s and 1980s to agree that, as then U.S. president Ronald Reagan put it, “a nuclear war cannot be won and must never be fought.”13) During the four decades of the Cold War, several generations of the Soviet military and defense industrial elite had learned and become accustomed to competing with the most powerful possible opponent, the United States, and such competition became their raison d’être. The end of the Cold War and of the nuclear arms race in the early 1990s deprived them of this supposedly glorious quest, and opposing rogue states and terrorists was not a noble substitute. U.S. and NATO operations in Yugoslavia and Iraq, however, provided a new hightechnology challenge, defined in Russia as air-space warfare, which was eagerly embraced as a new and fascinating domain of **seemingly endless competition** with a worthy counterpart. Besides, this new dimension of warfare doubtless gave the military and associated defense industries an opportunity to impress political leadership with newly discovered esoteric and **frightening threats**, justifying the prioritization of national defense, and hence arms procurement programs and large defense budgets. In any case, the Russian strategy for air-space war is directly connected to the problem of entanglement. Astonishingly—and this makes the concept look quite scholastic—its framers shed no light on the single most important question: Is the context for air-space war a global (or regional) nuclear war, or a non-nuclear war that pits Russia against the United States and NATO? If it is the former, then in the event of the large-scale use of ballistic missiles armed with nuclear warheads (and in the absence of effective missile defense systems), the Russian Air-Space Forces would be unlikely to function effectively. Except for issuing warnings about incoming missile attacks, they would not be able to fulfill the tasks assigned to them by Russia’s Military Doctrine, including “repelling air-space attacks and defending command sites of the top levels of state and military administration, strategic nuclear forces’ units, and elements of missile warning systems.”14 Alternatively, if air-space war assumes a non-nuclear conflict, then the concept raises serious doubts of a different nature. Russian state and military leaders have regularly depicted terrifying scenarios of large-scale conflicts being won through non-nuclear means. Former deputy defense minister General Arkady Bakhin, for example, has described how “leading world powers are staking everything on winning supremacy in the air and in space, on carrying out massive air-space operations at the outbreak of hostilities, to conduct strikes against sites of strategic and vital importance all across the country.”15 It is difficult to imagine, however, that such a conflict, in reality, would not quickly escalate to a nuclear exchange, especially as strategic forces and their C3I systems were continually attacked by conventional munitions. Right up until the mid-1980s, the military leadership of the USSR believed that a major war would likely begin in Europe with the early use by Warsaw Pact forces of hundreds of tactical nuclear weapons “as soon as [they] received information” that NATO was preparing to launch a nuclear strike.16 After that, Soviet armies would reach the English Channel and the Pyrenees in a few weeks, or massive nuclear strikes would be inflicted by the USSR and the United States on one another, and the war would be over in a few hours, or at most in a few days, with catastrophic consequences.17 After the end of the Cold War, the task of elaborating probable major war scenarios was practically shelved because such a war had become unthinkable in the new political environment. However, strategic thinking on the next high-technology global war apparently continued in secret (and probably not only in Russia). Now, at a time of renewed confrontation between Russia and the West, the fruits of that work are finally seeing the light of day. In all likelihood, the authors of the strategy imagine that over a relatively long period of time—days or weeks—the West would wage a campaign of air and missile strikes against Russia without using nuclear weapons. Russia, in turn, would defend against such attacks and carry out retaliatory strikes with long-range conventional weapons. Notably, in 2016, Russian Defense Minister Sergei Shoigu stated that “by 2021, it is planned to increase by four times the combat capabilities of the nation’s strategic non-nuclear forces, which will provide the possibility of fully implementing the tasks of non-nuclear deterrence.”18 In other words, the basic premise is that the U.S.-led campaigns against Yugoslavia in 1999 or Iraq in 1990 and 2003 (which are often cited by experts in this context) may be implemented against Russia—but with different results, thanks to the operations of the Russian Air-Space Forces, the Strategic Rocket Forces, and the Navy against the United States and its allies. The emphasis on defensive and offensive strategic non-nuclear arms does not exclude, but—on the contrary—implies the limited use of nuclear weapons at some point of the armed conflict. Sergei Sukhanov, one of the most authoritative representatives of the defense industries as the constructor general of the Vympel Corporation, which is responsible for designing strategic defense systems, has exposed the whole panorama of Russia’s contemporary strategic logic on the interactions between offensive and defensive systems and between nuclear and non-nuclear systems: If we cannot exclude the possibility of the large-scale use of air-space attacks by the U.S. and other NATO countries (i.e., if we accept that the Yugoslavian strategy might be applied against Russia), then it is clearly impossible to solve the problem by fighting off air-space attacks with weapons that would neutralize them in the air-space theater, since this would require the creation of highly effective air- and missile defense systems across the country. Therefore, the strategy for solving the air-space defense tasks faced in this eventuality should be based on deterring the enemy from large-scale air-space attacks by implementing the tasks facing air-space defense in this eventuality at a scale that would avoid escalation but force the enemy to refrain from further airspace attack.19 (Emphasis added.) In other words, because of the inevitable limitations in Russia’s ability to defend against air-space attacks, Sukhanov argues that Russia may have to resort to the limited use of nuclear weapons in order to compel the United States and its allies into backing down. This basic logic is **widely accepted** in Russia. Judging by the available information, the United States does not have—and is not expected to have for the foreseeable future—the technological means or the operational plans to wage non-nuclear air-space warfare against Russia. However, the fact that a major war with the United States and NATO is ***seen*** in contemporary Russian strategic thinking as a prolonged endeavor involving an integrated technological and operational continuum of nuclear and non-nuclear operations, defensive and offensive capabilities, and ballistic and aerodynamic weapons creates a breeding ground for entanglement. The result could be the rapid escalation of a local non-nuclear conflict to a **global nuclear war**. The remainder of this chapter discusses how new and emerging military technologies might contribute to such an escalation.

**Nuke war causes extinction**

Edwards 17 [(Paul N. Edwards, CISAC’s William J. Perry Fellow in International Security at Stanford’s Freeman Spogli Institute for International Studies. Being interviewed by EarthSky/card is only parts of the interview directly from Paul Edwards.) “How nuclear war would affect Earth’s climate,” EarthSky, September 8, 2017, earthsky.org/human-world/how-nuclear-war-would-affect-earths-climate] TDI

We are not talking enough about the climatic effects of nuclear war. The “nuclear winter” theory of the mid-1980s played a significant role in the arms reductions of that period. But with the collapse of the Soviet Union and the reduction of U.S. and Russian nuclear arsenals, this aspect of nuclear war has faded from view. That’s not good. In the mid-2000s, climate scientists such as Alan Robock (Rutgers) took another look at nuclear winter theory. This time around, they used much-improved and much more detailed climate models than those available 20 years earlier. They also tested the potential effects of smaller nuclear exchanges. The result: an exchange involving just 50 nuclear weapons — the kind of thing we might see in an India-Pakistan war, for example — could loft 5 billion kilograms of smoke, soot and dust high into the stratosphere. That’s enough to cool the entire planet by about 2 degrees Fahrenheit (1.25 degrees Celsius) — about where we were during the Little Ice Age of the 17th century. Growing seasons could be shortened enough to create really significant food shortages. So the climatic effects of even a relatively small nuclear war would be planet-wide. What about a larger-scale conflict? A U.S.-Russia war currently seems unlikely, but if it were to occur, hundreds or even thousands of nuclear weapons might be launched. The climatic consequences would be catastrophic: global average temperatures would drop as much as 12 degrees Fahrenheit (7 degrees Celsius) for up to several years — temperatures last seen during the great ice ages. Meanwhile, smoke and dust circulating in the stratosphere would darken the atmosphere enough to inhibit photosynthesis, causing disastrous crop failures, widespread famine and massive ecological disruption. The effect would be similar to that of the giant meteor believed to be responsible for the extinction of the dinosaurs. This time, we would be the dinosaurs. Many people are concerned about North Korea’s advancing missile capabilities. Is nuclear war likely in your opinion? At this writing, I think we are closer to a nuclear war than we have been since the early 1960s. In the North Korea case, both Kim Jong-un and President Trump are bullies inclined to escalate confrontations. President Trump lacks impulse control, and there are precious few checks on his ability to initiate a nuclear strike. We have to hope that our generals, both inside and outside the White House, can rein him in. North Korea would most certainly “lose” a nuclear war with the United States. But many millions would die, including hundreds of thousands of Americans currently living in South Korea and Japan (probable North Korean targets). Such vast damage would be wrought in Korea, Japan and Pacific island territories (such as Guam) that any “victory” wouldn’t deserve the name. Not only would that region be left with horrible suffering amongst the survivors; it would also immediately face famine and rampant disease. Radioactive fallout from such a war would spread around the world, including to the U.S. It has been more than 70 years since the last time a nuclear bomb was used in warfare. What would be the effects on the environment and on human health today? To my knowledge, most of the changes in nuclear weapons technology since the 1950s have focused on making them smaller and lighter, and making delivery systems more accurate, rather than on changing their effects on the environment or on human health. So-called “battlefield” weapons with lower explosive yields are part of some arsenals now — but it’s quite unlikely that any exchange between two nuclear powers would stay limited to these smaller, less destructive bombs.

**Currently, entrepreneurs are pushing for privatization of space travel with increasing success**

**Thompson 20** [(Clive, author of Coders: The Making of a New Tribe and the Remaking of the World, a columnist for Wired magazine, and a contributing writer to The New York Times Magazine) “Monetizing the Final Frontier The strange new push for space privatization,” December 3, 2020<https://newrepublic.com/article/160303/monetizing-final-frontier>] TDI

For longtime enthusiasts of NASA’s human spacefaring, it was a singularly auspicious moment. Ever since NASA’s space shuttles were mothballed in 2011, the agency had no American-owned way of getting people into space. It had been paying the Russian government to fly U.S. astronauts up and back, on Russia’s Soyuz spacecraft. But this flight was different. It was the first time humans had flown in a rocket and a capsule made by a private-sector company: SpaceX, the creation of the billionaire Elon Musk. The launch was also a SpaceX branding bonanza. The astronauts rode up to the rocket in a Tesla, Musk’s fabled luxury electric car; when they’d reached orbit, they broadcast a live video in which they thanked SpaceX for making the flight happen, and showed off the sleek capsule—a genuine marvel of engineering, with huge touch screen control panels that looked rather like the ones inside a Tesla itself. Over the next few years, NASA will pay Musk and SpaceX $2.6 billion to ferry astronauts to and from the space station six times. For the feds, this price tag is remarkably cheaper than the space shuttle, which cost over $1 billion per flight. In his speech after the launch, Trump lauded the cost savings that SpaceX had realized on the government’s behalf. SpaceX, he announced, “embodies the American ethos of big thinking and risk-taking.... Congratulations, Elon.” For Musk, though, the launch was more than just a technical success, and is bigger even than the $2.6 billion contract. It cements him as a leading player in what might seem the unlikeliest stage of the final frontier’s exploration—the privatization of space. Private-sector activity in space travel is accelerating dramatically—rocketing, one might say. For decades, ever since people first headed for orbit in the 1960s, spaceflight had been mostly the preserve of governments. States were the only actors with the money and technical acumen to blast things into the vacuum and get them safely down again. The private sector didn’t have NASA’s know-how, nor—more important—a business plan that could rationalize the massive outlay of capital required to operate in space. In the last few years, that calculus has changed dramatically. A generation of “New Space” entrepreneurs has begun launching rockets and satellites. Some seek to flood the planet with fast, cheap mobile-phone signals; others want to manufacture new products in zero gravity, harnessing the novel physics of such conditions to engineer substances that can’t be made in Earth’s gravity. Further afield, they’re aiming to harvest water on the moon and even mine asteroids. Backing this burst of entrepreneurial fervor are many billionaires who made their money in the early Wild West of the internet, including Amazon’s Jeff Bezos, with dreams of building space colonies, and Musk, the former PayPal titan who hopes to personally make it to Mars.Barack Obama’s administration made the first major overtures to the space privatizers, signing legislation that paved the way for today’s space boom. But the real land rush has occurred under Trump, via a flurry of executive orders designed to give private firms greater access to “low-Earth orbit.” Trump officials have even touted the idea of privatizing the $100 billion space station itself—the last signature NASA-sponsored human spacecraft project still aloft. When Trump’s transition team in 2017 pondered the handoff of low-Earth orbit to the private sector, it concluded: “This may be the biggest and most public privatization effort America has ever conducted.” Or as Texas GOP Senator Ted Cruz—at the time the chairman of the Space, Science, and Competitiveness Subcommittee—put it in 2018: “I predict the first trillionaire will be made in space.” The burst of activity and high-tech acumen thrills many space fans. But it is making many others quite nervous. Opening up space to a frenzy of private actors could, they agree, produce measurable benefits back on planet Earth—making crucial scientific research, environmental monitoring, and everyday communication cheaper. But the critics are quick to note as well that the history of privatization is spotty at best, with plenty of civically brutal knock-on effects: concentrations of monopolistic power, enfeebled democratic control, and widespread environmental degradation. We’ve seen all those problems appear on Earth as all manner of traditional social goods, from education and housing to pension plans and mass transit, have been targeted for private-sector control. Next up, it seems, is the great beyond.

**Privatization of space travel kills off public space exploration.**

**Two internal links—First, tradeoff—**

**Space exploration must be public-sector – entrepreneurs purposely understate the barriers to colonization, yet exploit its potential for financial gain.**

**Phillips 20** [(Leigh, science writer and EU affairs journalist, author of Austerity Ecology & the Collapse-Porn Addicts.) “We Don’t Need Elon Musk to Explore the Solar System,” May 8, 2021, https://jacobinmag.com/2021/05/elon-musk-space-exploration-mars-colonization] TDI

He opens the paper with a recognition that, at some point, if we stay on Earth, we will confront an eventual extinction event. “The alternative is to become a spacefaring civilization and a multi-planetary species.” He alights upon Mars as the obvious first option for establishing a “self-sustaining city — a city that is not merely an outpost, but which can become a planet in its own right.” He rejects Venus due to it being, as he correctly puts it, a super-high-pressure, hot acid bath. He rejects Mercury due to it being too close to the Sun, and the Moon for lack of atmosphere and its twenty-eight-day “day” (a Martian day, or “sol,” for comparison, is an Earthling-friendly 24.5 hours). And he rejects, at least for now, the moons of Jupiter or Saturn, as they are much harder to get to. Mars has more than its own share of habitability issues, but Musk does not mention them, other than to say that, while Mars is “a little cold” (in reality, -63ºC, or -81ºF, compared to Earth’s balmy 16ºC, or 57ºF), “we can warm it up.” The Martian atmosphere is “very helpful” because it’s primarily CO2, with some nitrogen and argon, meaning that “we can grow plants on Mars just by compressing the atmosphere.” Most cheery of all, Musk says it would be “quite fun” to be on Mars, because the gravity is about 38 percent that of Earth, making it easy to lift heavy things and “bound around.” Mars, as seen from space. (WikiImages via Pixabay) It’s all so simple. “We just need to change the populations because currently we have seven billion people on Earth and none on Mars.” And so the paper is primarily devoted to explaining how to solve that sole problem: how to lower the cost of a trip to Mars from the current roughly $10 billion per person down to the median cost of a house in the United States. By making rockets reusable, refilling in orbit, producing propellant on Mars, choosing the right propellant, and improving system design and performance, Musk reckons he can get the cost of a ticket down to $200,000, perhaps as little as $100,000. And Musk’s SpaceX has done a tremendous job so far of sharply reducing the cost of escaping Earth’s gravity well, primarily via deep vertical integration of the firm. It produces a whopping 70 percent of its components in-house, as opposed to the 1,200 different suppliers in the outsourced supply chain of its main competitor, the Boeing–Lockheed Martin partnership known as the United Space Alliance. Each of these suppliers extracts their own profit margin from every contract in the chain, jacking up the cost per launch to $460 million. SpaceX, by comparison, charges NASA and its other clients just $62 million per launch, and Musk says he has slashed the marginal cost of a reused Falcon 9 booster launch to a mere $15 million. Well done, Elon. Or, rather, well done to all the engineers, logistical experts, and other workers who have done most of the labor, allowing SpaceX to revolutionize the business model of getting to space. There is not really any mention of the enormous challenges of the atmosphere’s low pressure and toxic composition, the preponderance of deadly perchlorates in the soil, or the lack of magnetosphere to protect against solar and cosmic radiation. The current atmosphere of Mars is too thin to support most life: its pressure is only about 1 percent that of Earth. Only hypopiezotolerant microbes (those that live in low-pressure environments), such as ones that are lofted by winds into Earth’s stratosphere, would be able to survive. The atmosphere is also 95 percent carbon dioxide — fine for plants (if the pressure were able to be raised) but not for animals. Musk does say that once Mars is warmed up, “we would once again have a thick atmosphere and liquid oceans.” Bioremediation using bacteria to clean up perchlorates already occurs on Earth, but we are talking about an entire planet here. There is no discussion of how any of this might happen, over what time period, and who would pay for it. Same with the construction of an artificial magnetosphere. Dealing with the perchlorates alone would likely be profoundly more challenging and expensive than the relatively straightforward process of decarbonizing Earth’s economy. A 2018 NASA study found that there is insufficient CO2 and H2O from the Martian soil, polar ice caps, and minerals in the upper crust to get anywhere close to thickening the atmosphere and using it like a blanket to warm up the planet. All these sources combined would still only boost the pressure to about 7 percent of that of Earth. Carbon-bearing minerals deep in the crust might have enough CO2 to achieve the needed pressure, but nothing is known about their extent, and recovering them with current technology would be colossally energy intensive. Another idea is to direct comets or asteroids to crash into Mars and release their greenhouse gases that way. Again, these are fantastical ideas that will be impractical for many, many generations yet to come. NASA astronauts in space. (NASA) And there is likely no way of ever overcoming Mars’s low gravity. If you added all the mass of Venus to that of Mars, smashing the planets together, even then, you would still not quite achieve Earth’s gravity. It is true that we do not know what the physiological effects of 38 percent of Earth’s gravity are, either on humans or other life. We have two data points: Earth gravity, what we call 1G, and the 0G microgravity of the International Space Station (ISS). But from studies of astronauts who have spent extended periods aboard the ISS, we know that 0G is extremely bad for human health. Muscles atrophy. Tendons and ligaments begin to fail. Facial and finger muscles, which cannot be worked out via onboard gyms or treadmills, weaken. The spine lengthens, with astronauts gaining an inch or two in height and suffering from back pain. Bones demineralize, losing density at a rate of 1 percent per month. As Christopher Wanjek, a former NASA science writer and author of 2020 book Spacefarers — which is an optimistic volume on the viability of manned space travel — notes: “To visualize how bad that bone loss is, consider the fact that the major obstacle to fully recycling urine into drinking water on the ISS is that the filters get clogged daily with calcium deposits.” Wanjek writes how the rate of vision loss is such that a crew to Mars would need to pack eyeglasses with various prescriptions for “each phase of their gradual, inevitable, and permanent vision loss.” Kidneys get confused by blood not being where it’s supposed to be and think there is an excess, so they start to remove what they believe to be excess water. The blood thickens, driving a reduced production of red blood cells, which in turn drives anemia, shortness of breath, lethargy, and greater likelihood of infection. Perhaps worst of all, brain compression resulting from microgravity negatively impacts regions responsible for fine motor movement and executive function — deteriorations that could be permanent. A range of interventions, including exercise, drugs, and compression clothing can shave the sharp edges off some of these effects, but ultimately, the solution on a spacecraft is the simulation of gravity via centrifugal force — a spinning ship. This is not something that you can do with a whole planet. It is for this reason that Venus, with its gravity not too far off that of Earth, may actually be a better terraforming candidate than Mars — one day — despite its currently inhospitable atmosphere. The Real Business of SpaceX Isn’t Mars One has to suspect that Musk knows all this. We have a hint of this when, at one point in his paper, Musk concedes that it will be difficult to fund his vision just by slashing the cost of getting to space. He admits that SpaceX expects to generate substantial cash flow from launching lots of satellites and servicing the International Space Station for NASA. Additional help for bankrolling the Mars project might come from the emergence of a market for really fast transportation of things or people around the world by rocket: cargo could be transported anywhere on Earth in forty-five minutes, and a trip from New York to Tokyo could take a mere twenty-five minutes (so long as takeoff and landing takes place where the tremendous noise, as he puts it in hip-CEO-speak, “is not a super-big deal”). As a result, one gets the impression by reading between the lines that a self-sustaining Martian city is all just an impressive marketing maneuver taking advantage of most people’s sense of adventure and wonder; of our species’ ancient need to wander and explore. The real business of SpaceX was never a Martian colony but rather servicing a mature satellite market, stealing government space contracts from the likes of Boeing, and kicking off a terrestrial rocket transport sector. The dream of Mars is, in this case, not really any different from the adman’s fiction of romance and aspiration that sells a can of Pepsi or a Jeep. The dream of Mars is, in this case, not really any different from the adman’s fiction of romance and aspiration that sells a can of Pepsi or a Jeep. None of this is to suggest that establishing an outpost on Mars for the purposes of scientific exploration should not be attempted, even in the next couple of decades. But an outpost, as Musk himself makes clear, does not approach a self-sustaining city, and still less a multi-planetary species. Because humans do need to exit Earth at some point in order to maintain the species, if we are to establish genuinely self-sustaining colonies, then terraforming will likely be necessary one day, as well as interstellar generation ships that take us to habitable exoplanets far beyond the solar system. For all of this, we will have to figure out how to take our ecology with us. We are not really the collection of individuals we thought we were, but rather are deeply embedded within our ecosystems. Indeed, each of us is a microbial ecosystem whose edges are vague. Where does the bacterial, fungal, and viral multitude that is “me” stop and my equally microbiological environment begin? This does not mean that Earth will be the only home we ever have, but it does mean that the antiseptic, forestless, riverless Starship Enterprise would leave its inhabitants very sick before too long. How much of our ecology do we need to take with us, though? We just don’t know yet. The science of ecology is very much still a young discipline. This is where fantastical science-fiction conceptions of vast ships made from hollowed out asteroids and packed with different biomes fills the gap of what we do not know. Likewise for novels like Becky Chambers’s To be Taught, if Fortunate, in which, instead of terraforming other worlds, adapting them to our needs, we genetically alter our bodies via “somaforming” to adapt ourselves to their conditions. Plainly, then, there is no rush for any of this, even as there is a moral imperative for us, one day in the distant future, to permanently exit Earth. Our colonization of other worlds is akin to the building of the grandest cathedral we have ever envisaged: a project that will take centuries, or more likely millennia, many millennia. This is nothing that a private company can deliver. There is no near-term return on investment; indeed, there is no aim of profitability at all, but rather of our species’ survival through the eons.

**Privatization of space travel makes it politically polarizing and drains public support.**

**Phillips 20** [(Leigh, science writer and EU affairs journalist, author of Austerity Ecology & the Collapse-Porn Addicts.) “We Don’t Need Elon Musk to Explore the Solar System,” May 8, 2021, https://jacobinmag.com/2021/05/elon-musk-space-exploration-mars-colonization] TDI

Elon Musk is right to dream of humanity’s future as a multi-planet species. However, the multigenerational, millennia-long project of **space colonization will be a public-sector endeavor, or it will not happen.** Elon Musk, the third-richest man in the world, CEO of SpaceX and Tesla (and dabbler in online edgelord provocation), issued a strange Twitter post last month in defense of his wealth. “I am accumulating resources to help make life multiplanetary & extend the light of consciousness to the stars,” he declared. And then, this week, the centibillionaire further provoked when he mentioned in an interview about Martian colonization that, while it would be a glorious experience, “a bunch of people will probably die in the beginning.” All this within days of NASA’s Perseverance Mars mission achieving the first helicopter flight on another planet and producing five grams of oxygen from the planet’s carbon dioxide–dominant atmosphere — two major milestones in space exploration. A reasonable critique of Musk’s SpaceX endeavors might begin by noting that, regardless of how noble an aim Musk may have for his centibillions, there simply should not be centibillionaires (or even regular millionaires and billionaires). One might also echo Neil Armstrong’s criticism of private space flight — a criticism that once made Elon cry when 60 Minutes asked him about his hero arguing against the privatization of space. We might note how space exploration during the Cold War, despite the militarist overtones of the Space Race, was explicitly intended to be for all mankind rather than in service of the jollies of ultrarich space tourists. A democratic and public redirection of Elon Musk’s billions might be spent differently. One might further assert that, given the non-identity of the set of all things that are beneficial and the set of all things that are profitable, space colonization will be a public-sector endeavor, or it will not happen — as such a private space travel has no near-term, medium-term, or even long-term prospect of any return on financial investment beyond servicing low-earth, medium-earth, or geostationary orbit. And, finally, we might denounce the union-busting at Musk’s factories or even argue that his “accumulation of resources” is less the product of his own efforts than it is primarily an upward redistribution of value created by his workers. That is to say that there are a raft of progressive critiques of Musk that could be made that nevertheless still value space exploration and, one day, human colonization of the cosmos. Indeed, if one values space exploration and looks forward to the time, as astronomer Carl Sagan put it, “when most human cultures will be engaged in an activity you might describe as a dandelion going to seed,” then a socialist critique is all the more necessary, given the irrational limitations markets impose on human endeavor. There are a raft of progressive critiques of Elon Musk that could be made that nevertheless still value space exploration and, one day, human colonization of the cosmos. But instead, there are thousands of snark-drenched tweets sneering at how crackpot, masculinist, and even childish Elon’s dream is. They argue that space travel is a waste of resources that would be better spent solving problems here on Earth, and that space colonization is a repetition of the colonization of the New World. Even Bernie Sanders responded to Musk by saying: “Space travel is an exciting idea, but right now we need to focus on Earth and create a progressive tax system so that children don’t go hungry, people are not homeless and all Americans have healthcare. The level of inequality in America is obscene and a threat to our democracy.” At the time of writing, the senator’s tweet had received some 95,000 likes. Bernie is, in this case, wrong. Space exploration, including space travel, is one of the grandest tasks humanity has ever set for itself. It is a false dichotomy — and an austerian one at that — to say that we do not have enough money for both a space program and social justice or environmental protection. We can more than afford to do both. NASA’s budget is but a fraction of the Pentagon’s. It should not be difficult to imagine a democratic socialist economy, or even just one a little less neoliberal, that permits much more space and much less war. We can have public health care and science. We can end homelessness and explore the cosmos. We can have unionized, family-supporting jobs for all and, one day, almost certainly some considerable time from now, colonies on other worlds. The Postcolonial Space Programs Let me offer a personal anecdote about how I came to change my mind about this. A few years ago, I was researching the space programs of developing nations in Sub-Saharan Africa and South America for a feature article for a science magazine. While I have always been a cheerleader for space science, I had heard that, in some cases, the states concerned did not really have the capacity for such activities and were doing little more than rebranding British or American satellites launched from Russian spaceports. I thought I would have a nice story of neoliberal regimes wasting what little money these countries had on vanity projects that were of dubious national provenance. So I got in touch with some of the British and American engineers that had worked on these projects and interviewed them off the record. To varying degrees, they conceded that this was more or less what was happening in some places, but not in others, where a country was more advanced and did have at least some of the capacity necessary. Off the record, they told stories of corruption and incompetence, delays and malfunctions. But they also said that there was a learning process and there absolutely was a transfer of skills and knowledge. It was a mixed bag, they said. It is a false dichotomy — and an austerian one at that — to say that we do not have enough money for both a space program and social justice or environmental protection. More than this, what told me that made me completely rethink my attitude toward developing world space programs. They said that, however much they might have questioned the priority given to a space program for a country without functioning roads or sewage systems, everywhere they went, when they said why they were in the country, ordinary people would respond by bursting with pride that their country, too, was going into space. For them, it symbolized that they were just as good as any developed nation, that modernity was coming, and that they, too, could be explorers and pioneers. I put away my story and never wrote it. Instead, I investigated the decline of mathematical training in Africa in the neoliberal era. During the postcolonial era, African socialist governments had been committed to developing a cadre of professionals schooled in advanced mathematics and science, sometimes with the assistance of the Soviet Union, sometimes with aid from the United States or France, depending on the contingencies of the Cold War. But the indifference that followed the end of the Cold War and the advent of neoliberalism had gutted such training, and now, in many countries, the aging, mathematically trained professionals were retiring or dying with no one to replace them. Such training is essential not just for scientific research but for civil engineering, national budgeting, and enterprise planning. Thankfully, a celebrated physicist, Neil Turok — also the son of the man who crafted the South African ANC’s armed struggle strategy, Ben Turok — had started a new institute expressly committed to reviving Africa’s mathematical capacity. I wrote about that instead. We can today spend on both space exploration and mathematics education — and we could have in the 1960s. We don’t only need charity, but we need vaulting ambition as well: not just social programs but science. Or, put another way: we want bread, but we want roses, too. How Venus Helped Us Understand Global Warming But even if Bernie made an unwittingly neoliberal argument by imagining there is not enough wealth in America to afford both an ambitious space program and luxuriant social programs, he did at least state that he thought space travel was exciting. It was a matter of prioritization rather than outright opposition. There were others, however, who attacked the very idea of going into space, not least at a time of climate emergency. We should focus on this living planet rather than unfathomably distant dead ones, they said. This is not a one-off; Left critics of space programs repeatedly issue calls for a focus on the environmental challenges Earth faces instead of going to space. But this is a second false dichotomy. Space science, in so many respects, is Earth science. NASA is perhaps the premier Earth science research agency in the world. Its Landsat program, originally named the Earth Resources Technology Satellite and dating back to 1972, is the longest running effort to deliver satellite imagery of the planet. Its latest iteration, Landsat 8, launched in 2013 and delivers millions of images free of charge to researchers or any member of the public, tracking forest loss and degrowth, glacier and icecap melt, land-use change and agricultural water use. Left critics of space programs repeatedly issue calls for a focus on the environmental challenges Earth faces instead of going to space. But space science, in so many respects, is Earth science. Then there is AIRS, the Atmospheric Infrared Sounder, on NASA’s Aqua satellite, which gathers infrared energy emitted from Earth’s surface and atmosphere and measurements of temperature and water vapor that are used to assess the accuracy of climate models, detect volcanic plumes, and forecast droughts. The Geostationary Carbon Observatory (GeoCarb), yet to launch, will monitor greenhouse gas emissions, and the Ice, Cloud and land Elevation Satellite-2 (ICESat-2) mission will measure ice-sheet elevation, sea-ice thickness, and tree-canopy height to track changes in Greenland and Antarctica ice and assess changes in the total mass of the world’s vegetation. As of 2021, there are some forty different current and soon-to-launch Earth science missions performed by NASA. When we send missions to other worlds, again, learning about them teaches us as much about Earth as they do about the Moon, Mars, Venus, Europa, Titan, or Enceladus. Let’s remember that climatologist James Hansen — whose 1988 congressional testimony on global warming was one of the main catalysts of early public and political awareness of the climate emergency — had his start studying the transfer of radiation through the Venusian atmosphere. It was his work investigating Venus — a planet with a runaway greenhouse effect — that led him to work on climate change on Earth. Indeed, the study of the atmospheres of both Venus and Mars is a key part of the story of how we discovered global warming. Robots vs. Humans One might respond that all of this is unmanned space exploration. Surely steady advances in robotics and miniaturization have weakened the case for manned spaceflight. Robots like the Perseverance rover (nicknamed Percy), which recently landed in Jezero Crater on Mars aiming, among other goals, to search for evidence of ancient microbial life, are much more able to access extreme environments inhospitable to humans and at a much lower cost. But while there are many things robots can do that humans cannot, there are also many things humans can do that robots cannot and will never be able to (at least until the advent of artificial general intelligence). As British planetary scientist Ian Crawford argues, humans have the advantage over robots with respect to on-the-spot decision-making and flexibility and thus increased probability of making serendipitous discoveries. There is also greater efficiency of sample collection and return with humans (382 kg of moon rocks returned by Apollo vs the 0.32 kg from the sample returns of the Soviet Union’s robotic Luna missions), and greater potential for large-scale exploratory activity, deployment, and maintenance of complex equipment. But it is the universal problem-solving capability of humans that is key. Crawford quotes Steve Squyres, the principal investigator for the Mars exploration rovers Spirit and Opportunity, who concluded in 2005: “The unfortunate truth is that most things our rovers can do in a perfect sol [a Martian day] a human explorer can do in less than a minute.” An artist’s rendering of the Perseverance rover on Mars. (Tim Tim / Wikimedia Commons) And we see this in the scientific literature. Comparing the number of refereed publications resulting from the Apollo moon missions (the only human exploration missions) with those from robotic missions to the Moon and Mars, Crawford finds the former has produced a much greater volume. Dividing the cumulative number of publications by days of fieldwork on the surface, Crawford gauges that the Apollo project was three orders of magnitude more efficient in producing scientific papers per day than its unmanned counterparts, while being about one or two orders of magnitude more expensive. He notes that the next most productive missions are the Luna sample return missions. This shows how important sample return is, and indeed, one of Percy’s goals is to collect rock and regolith (“soil”) samples that, at some point in the early 2030s, will be retrieved by a “fetch rover” mission and sent back to Earth via a Mars Ascent Vehicle, a miniature rocket whose design has yet to be agreed. One of the main reasons robotic missions have been cheaper is that they do not return. The return mission thus bumps up the cost. But the quantity and diversity of samples will not be as high as a human mission could deliver. He is keen to stress that none of this should downplay the importance of robotic Martian sample return, which is necessary until humans can safely be sent to Mars and back. The point is to correct the erroneous notion that manned space missions are merely white elephants servicing national pride in contests with geopolitical rivals such as the USSR or China but have no real scientific purpose. Even though the priority should be, and very much is, on robotic exploration, we will learn more if we do both over time than if we depend upon robotic exploration alone. Robots enhance rather than replace human exploration. The Prison of the Possible One might then argue, nevertheless, that, given the exorbitant cost of space travel, whether by human, robot, or satellite (a robot of a sort), we should still, as Bernie’s tweet stated, focus instead on hunger, homelessness, and health care on Earth. Prioritization of spending will always be necessary, but a strictly utilitarian approach that demands we cannot spend on large scientific endeavors until poverty and inequality are eradicated would likewise have to rule out other big-ticket but curiosity-driven science efforts such as the Large Hadron Collider. Indeed, it also follows that any scholarship that is not applied research with a demonstrably near-term human benefit should be halted until all other problems are solved, expensive or not. Of course, applied research would sooner or later come to a halt as well under such a utilitarian research regime as, by definition, applied research is an application of basic research. Those in the seventeenth century who thought, “Isn’t it kind of neat and weird that when I rub a piece of amber against a cat’s fur, the amber can pick up a feather? I wonder why this is,” had no notion that any investigation into the phenomenon of what we now call electricity would one day result in applications that power much of the world. And the demand that we only engage in activities with clear utility requires that all resources allocated to art and music be shifted elsewhere. How like the university administration philistines we see today slashing humanities funding to deliver more to STEM subjects, mothballing language courses and classics programs!

**Second, debris— Incoming mega-constellations of satellites ensure unmanageable space debris, triggering the Kessler Syndrome.**

**Boley & Byers 21** [Aaron C., Department of Physics and Astronomy @ The University of British Columbia\*, and Michael, Department of Political Science @ The University of British Columbia; Published: 20 May 2021; Scientific Reports; “Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth,”<https://www.nature.com/articles/s41598-021-89909-7>] brett

Companies are placing satellites into orbit at an unprecedented frequency to build **‘mega-constellations’** of communications satellites in Low Earth Orbit (**LEO**). **In two years**, the number of active and defunct satellites in **LEO** has increased by over 50%, to about **5000** (**as of** 30 March **2021**). **SpaceX** **alone** is on track to add 11,000 more as it builds its Starlink mega-constellation and has already filed for permission for another 30,000 satellites with the Federal Communications Commission (FCC)1. Others have similar plans, including **OneWeb, Amazon, Telesat,** and GW, which is a Chinese state-owned company2. The current governance system for LEO, while slowly changing, is ill-equipped to handle **large satellite systems**. Here, we outline how applying the consumer electronic model to satellites could lead to **multiple tragedies of the commons**. Some of these are well known, such as impediments to **astronomy** and an increased risk of **space debris**, while others have received insufficient attention, including changes to the **chemistry** of Earth’s **upper atmosphere** and **increased dangers** on Earth’s surface from **re-entered debris**. The heavy use of certain orbital regions might also result in a de facto exclusion of other actors from them, violating the 1967 **O**uter **S**pace **T**reaty. All of these challenges could be addressed in a coordinated manner through multilateral law-making, whether in the United Nations, the Inter-Agency Debris Committee (IADC), or an ad hoc process, rather than in an uncoordinated manner through different national laws. Regardless of the law-making forum, **mega-constellations** require a shift in perspectives and policies: from looking at single satellites, to evaluating systems of thousands of satellites, and doing so within an understanding of the limitations of Earth’s environment, including its orbits.

Thousands of **satellites** and 1500 rocket bodies provide **considerable mass** in LEO, which can break into debris upon **collisions**, explosions, or **degradation** in the **harsh space environment**. **Fragmentations** increase the **cross-section of orbiting material**, and with it, the **collision probability** per time. Eventually, collisions could dominate on-orbit evolution, a situation called the **Kessler Syndrome**3. There are already over 12,000 trackable debris pieces in LEO, with these being typically 10 cm in diameter or larger. Including sizes down to 1 cm, there are about a million inferred debris pieces, all of which threaten satellites, spacecraft and astronauts due to their orbits crisscrossing at high relative speeds. Simulations of the **long-term evolution** of debris suggest that LEO is already in the protracted **initial stages of the Kessler Syndrome**, but that this could be managed through **a**ctive **d**ebris **r**emoval4. The addition of satellite **mega-constellations** and the general proliferation of low-cost satellites in LEO **stresses the environment further**5,6,7,8.

Results

The overall setting

The rapid development of the space environment through mega-constellations, predominately by the ongoing construction of Starlink, is shown by the cumulative payload distribution function (Fig. 1). From an environmental perspective, the slope change in the distribution function defines NewSpace, an era of dominance by commercial actors. Before 2015, changes in the total on-orbit objects came principally from fragmentations, with effects of the 2007 Chinese anti-satellite test and the 2009 Kosmos-2251/Iridium-33 collisions being evident on the graph.

Figure 1

[Figure 1 omitted]

Cumulative on-orbit distribution functions (all orbits). Deorbited objects are not included. The 2007 and 2009 spikes are a Chinese anti-satellite test and the Iridium 33-Kosmos 2251 collision, respectively. The recent, rapid rise of the orange curve represents NewSpace (see "Methods").

Full size image

Although the volume of space is large, individual satellites and satellite systems have specific functions, with associated altitudes and inclinations (Fig. 2). This increases congestion and requires active management for station keeping and collision avoidance9, with automatic collision-avoidance technology still under development. Improved space situational awareness is required, with data from operators as well as ground- and space-based sensors being widely and freely shared10. Improved communications between satellite operators are also necessary: in 2019, the European Space Agency moved an Earth observation satellite to avoid colliding with a Starlink satellite, after failing to reach SpaceX by e-mail. Internationally adopted ‘right of way’ rules are needed10 to prevent games of ‘chicken’, as companies seek to preserve thruster fuel and avoid service interruptions. SpaceX and NASA recently announced11 a cooperative agreement to help reduce the risk of collisions, but this is only one operator and one agency.

Figure 2

[Figure 2 omitted]

Orbital distribution and density information for objects in Low Earth Orbit (LEO). (Left) Distribution of payloads (active and defunct satellites), binned to the nearest 1 km in altitude and 1° in orbital inclination. The centre of each circle represents the position on the diagram, and the size of the circle is proportional to the number of satellites within the given parameter space. (Right) Number density of different space resident objects (SROs) based on 1 km radial bins, averaged over the entire sky. Because SRO objects are on elliptical orbits, the contribution of a given object to an orbital shell is weighted by the time that object spends in the shell. Despite significant parameter space, satellites are clustered in their orbits due to mission requirements. The emerging Starlink cluster at 550 km and 55° inclination is already evident in both plots (Left and Right).

Full size image

When completed, **Starlink** will include about as many satellites as there are trackable debris pieces today, while its **total mass will equal all the mass currently in LEO**—over 3000 tonnes. The satellites will be placed in narrow orbital shells, creating **unprecedented congestion**, with 1258 already in orbit (as of 30 March 2021). **OneWeb** has already placed an initial 146 satellites, and **Amazon,** **Telesat,** **GW** and **other companies,** operating under different national regulatory regimes, are soon likely to follow.

**Enhanced collision risk**

Mega-constellations are composed of **mass-produced satellites** with **few backup systems**. This consumer electronic model allows for short upgrade cycles and rapid expansions of capabilities, but also **considerable discarded equipment**. SpaceX will actively de-orbit its satellites at the end of their 5–6-year operational lives. However, this process takes 6 months, so roughly 10% will be de-orbiting at any time. If other companies do likewise, thousands of **de-orbiting satellites** will be slowly passing through the same congested space, posing collision risks. Failures will increase these numbers, although the long-term failure rate is difficult to project. Figure 3 is similar to the righthand portion of Fig. 2 but includes the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC (see “Methods”). The large density spikes show that some shells will have satellite number densities in excess of n=10−6 km−3.

Figure 3

[Figure 3 omitted]

Satellite density distribution in LEO with the Starlink and OneWeb mega-constellations as filed (and amended) with the FCC. Provided that the orbits are nearly circular, the number densities in those shells will exceed 10–6 km−3. Because the collisional cross-section in those shells is also high, they represent regions that have a high collision risk whenever debris is too small to be tracked or collision avoidance manoeuvres are impossible for other reasons.

Full size image

Deorbiting satellites will be tracked and operational satellites can manoeuvre to avoid close conjunctions. However, this depends on ongoing communication and cooperation between operators, which at present is ad hoc and voluntary. A recent letter12 to the FCC from SpaceX suggests that some **companies might be less-than-fully transparent** about events13 in LEO.

Despite the congestion and traffic management challenges, FCC filings by **SpaceX** suggest that collision avoidance manoeuvres can in fact maintain collision-free operations in orbital shells and that the probability of a collision between a non-responsive satellite and tracked debris is negligible. However, the **filings do not account for untracked debris**6, including untracked debris decaying through the shells used by Starlink. Using simple estimates (see “Methods”), the probability that a single piece of untracked debris will hit any satellite in the Starlink 550 km shell is about 0.003 after one year. Thus, if at any time there are 230 pieces of **untracked debris** decaying through the 550 km orbital shell, there is a **50% chance** that there will be one or more collisions between satellites in the shell and the debris. As discussed further in “Methods”, such a situation is plausible. Depending on the balance between the de-orbit and the collision rates, if **subsequent fragmentation** events lead to **similar amounts of debris within that orbital shell**, **a runaway cascade of collisions could occur**.

Fragmentation events are not confined to their local orbits, either. The India 2019 ASAT test was conducted at an altitude below 300 km in an effort to minimize long-lived debris. Nevertheless, debris was placed on orbits with apogees in excess of 1000 km. As of 30 March 2021, three tracked debris pieces remain in orbit14. Such long-lived debris has high eccentricities, and thus can cross multiple orbital shells twice per orbit. **A major fragmentation event from a single satellite could affect all operators in LEO**.

Even if debris collisions were avoidable, meteoroids are always a threat. The cumulative meteoroid flux15 for masses m > 10–2 g is about 1.2 × 10–4 meteoroids m−2 year−1 (see “Methods”). Such masses could cause non-negligible damage to satellites16. Assuming a Starlink constellation of 12,000 satellites (i.e. the initial phase), there is about a 50% chance of 15 or more meteoroid impacts per year at m > 10–2 g. Satellites will have shielding, but events that might be rare to a single satellite could become common across the constellation.

One partial response to these congestion and collision concerns is for operators to construct mega-constellations out of a smaller number of satellites. But this does not, individually or collectively, eliminate the need for an all-of-LEO approach to evaluating the effects of the construction and maintenance of any one constellation.

**Commercial rocket launches produce space clutter—increased debris could reach a tipping point**

**Thompson 20** [(Clive, author of Coders: The Making of a New Tribe and the Remaking of the World, a columnist for Wired magazine, and a contributing writer to The New York Times Magazine) “Monetizing the Final Frontier The strange new push for space privatization,” December 3, 2020<https://newrepublic.com/article/160303/monetizing-final-frontier>] TDI

“Physics tells us that two things can’t occupy the same space at the same time or else bad things happen,” Jah said dryly. Indeed, there’s already been one collision that produced sprawling orbital pollution. In 2009, a satellite owned by the U.S. firm Iridium slammed into a decommissioned Russian government satellite at more than 26,000 mph. The crash produced 2,300 pieces of debris, spraying off in all directions. And debris is a particularly gnarly problem in space, because when it’s traveling at thousands of miles an hour, even a marble-size chunk is like a bullet, capable of rendering a damaged satellite inoperable and unsteerable—the owner can no longer fire its boosters to guide it into a higher or lower orbit. There are currently an estimated 500,000 marble-size chunks up there. Decades of space travel by governments left plenty of refuse, ranging from parts of rocket boosters to stray bits of scientific experiments. One particularly grim vision of the future that haunts astronomers is the “Kessler syndrome,” proposed by the astrophysicist Donald Kessler in 1978. Kessler hypothesized that space clutter could reach a tipping point: One really bad collision could produce so much junk that it would trigger a chain reaction of collisions. This disaster scenario would leave hundreds of satellites eventually destroyed, and create a ring of debris that would make launching any new satellites impossible, forever. “Near space is finite—it’s a finite resource,” Jah said. “So now you have this growing trash problem that isn’t being remediated.... And if we exceed the capacity of the environment to carry all this traffic safely, then it becomes unusable.” That’s why a growing chorus of critics are already making the case that space is the next major environmental area to protect, after the oceans and land on Earth. “People seem to really treat resources in space as being infinite,” said Erika Nesvold, an astrophysicist who’s the cofounder of The JustSpace Alliance. “As we’ve seen, people don’t really intuitively understand exponential growth.” That’s the dilemma in a nutshell: The available room in the sky is limited, but the plans for growth are exponential. SpaceX isn’t the only New Space firm looking to toss up satellites. Satellite and rocket start-ups are now lining up en masse, atop new waves of investment. There are satellites geared up to connect to “the internet of things” so companies can communicate among proprietary networks of household devices. There are floating cameras pointing down—so as to gather “geospatial intelligence,” which is to say data streamed from “the vantage point you get from satellites looking down on Earth and giving us information about our planet,” as the venture capitalist Anderson told me. And new forms of satellite vision are emerging all the time, such as cameras that can see at night, or are specially designed to see agriculture. Experiments abound, and so satellite launches will inevitably multiply in their wake. Part of what makes near-Earth orbit so chaotic is that it is, at the moment, remarkably unregulated—not unlike the internet of the early ’90s. An American firm has to get permission from the Federal Communications Commission to launch a satellite, but once it’s in orbit, there’s no federal agency that can compel it to move out of the path of a collision. Satellite owners generally don’t like to move if they can avoid it, because their satellites have a limited amount of fuel; any movement decreases their usable lifespan. On top of that, there are dozens of nations shooting satellites into low-Earth orbit—but no international body coordinating their flight paths. Last fall, the European Space Agency realized one of SpaceX’s new Starlink satellites was on a dangerously close path to an ESA satellite. SpaceX said it had no plans to move the satellite; so the ESA decided to fire its thrusters and get clear. This high-stakes negotiation was conducted via email. What’s more, space debris is extremely hard to source. If a British satellite slams into yours, you can probably figure out who hit you. But if your satellite is wrecked by a random piece of junk, nobody has any clue where that debris came from. It is, in this way, a neat parallel to the problem of C02, where a ceaseless barrage of tiny commercial decisions creates a sprawling problem—one that’s all but designed to ensure that everyone who caused it can deny responsibility. And damage is asymmetric: A company with a small $60,000 satellite could smash into a wildly expensive one paid for by U.S. taxpayers. “A National Reconnaissance Office satellite is at least a billion dollars, if not more, so they have a lot more to lose if something hits a satellite,” Bhavya Lal, a researcher at the IDA Science and Technology Policy Institute, noted. “As more private activity starts to happen, there’s more chances of that loss of control, too.” One might dismiss all this anxiety as a sort of sci-fi version of hippie environmentalism—except that even the administrator of NASA is deeply worried about the chaos and destruction likely to be sown by commercial activity in near-Earth orbit. Jim Bridenstine, the Trump-appointed head of NASA, is as pro-market as one can be. He praises SpaceX every chance he gets; he talks about privatizing the space station. But when I asked him about the looming danger of space debris, during a press-conference call, he conceded that it’s a huge, unresolved issue.

**Space dust wrecks satellites and debris exponentially spirals**

Intagliata 17 [(Christopher Intagliata, MA Journalism from NYU, Editor for NPRs All Things Considered, Reporter/Host for Scientific American’s 60 Second Science) “The Sneaky Danger of Space Dust,” Scientific American, May 11, 2017,<https://www.scientificamerican.com/podcast/episode/the-sneaky-danger-of-space-dust/>] TDI

When tiny particles of space debris slam into satellites, the collision could cause the emission of hardware-frying radiation, Christopher Intagliata reports. Aside from all the satellites, and the space station orbiting the Earth, there's a lot of trash circling the planet, too. Twenty-one thousand [baseball-sized chunks](https://www.scientificamerican.com/article/orbital-debris-space-fence/) of debris, [according to NASA](https://www.orbitaldebris.jsc.nasa.gov/faq.html). But that number's dwarfed by the number of small particles. There's hundreds of millions of those. "And those smaller particles tend to be going fast. Think of picking up a grain of sand at the beach, and that would be on the large side. But they're going 60 kilometers per second." Sigrid Close, an applied physicist and astronautical engineer at Stanford University. Close says that whereas mechanical damage—like punctures—is the worry with the bigger chunks, the dust-sized stuff might leave more insidious, invisible marks on satellites—by **causi**ng electrical damage. "We also think this phenomenon can be attributed to some of the failures and anomalies we see on orbit, that right now are basically tagged as 'unknown cause.'" Close and her colleague Alex Fletcher modeled this phenomenon mathematically, based on plasma physics behavior. And here's what they think happens. First, the dust slams into the spacecraft. Incredibly fast. It vaporizes and ionizes a bit of the ship—and itself. Which generates a cloud of ions and electrons, traveling at different speeds. And then: "It's like a spring action, the electrons are pulled back to the ions, ions are being pushed ahead a little bit. And then the electrons overshoot the ions, so they oscillate, and then they go back out again.” That movement of electrons creates a pulse of electromagnetic radiation, which Close says could be the culprit for some of that electrical damage to satellites. The study is in the journal Physics of Plasmas. [Alex C. Fletcher and Sigrid Close, [Particle-in-cell simulations of an RF emission mechanism associated with hypervelocity impact plasmas](http://aip.scitation.org/doi/full/10.1063/1.4980833)]

**The modern food system relies on satellites. Collapse triggers global shocks to supply.**

**Tompkins 19** [Steven, Inmarsat’s Director of Sector Development for Agriculture. Head of Resilient and Sustainable Supply Chains Team at ADAS. Entrepreneurial manager with a sustained track record of building new profitable business streams for science-based organizations in the agri-food sector.; 3-18-2019; "Enabling the connected farm – the importance of satellite communications," Inmarsat,<https://www.inmarsat.com/blog/enabling-the-connected-farm-the-importance-of-satellite-communications/>] brett

The Agri-Tech Revolution, Agriculture 4.0, the smart and connected farm. There is no shortage of buzzwords hinting at a digitalised future, or solutions being touted as game-changing for the global agricultural industry. Commonly claimed benefits include **increasing crop yields**, and **a reduction in input costs and the reliance on manual labour.** Many of these solutions rely on reliable internet connectivity in the field to push data from one place to another, but there are still vast swathes of agricultural land that suffer from unreliable or non-existent connectivity, either lacking cellular or broadband connectivity. If we are to take advantage of the huge possibilities available to us, overcoming our connectivity challenges will be crucial. **This is where satellite communications can help**. When I tell people that I am an agriculturalist working for a satellite company, almost always the response is related to an experience of using space imagery (known as Earth Observation) to help automate processes such as crop scouting. But there is another breed of satellites that don’t produce images but do provide fast and reliable internet and voice communications across the world in areas that cellular and fibre connectivity cannot reach. Ubiquitous connectivity from satellites opens up huge possibilities for farmers in remote areas to take advantage of the Agri-Tech Revolution. In some cases, this is as simple as connecting frontline worker teams in large plantations to operations centres to prioritise workload and create efficiencies. Taking it one step further, satellite communications can be a bridge to enable farmers to connect data producing devices in the field (**such as weather stations, sensors, data from farm machinery) to business applications.** Known by the tech world as the ‘Internet of Things’ or IoT, this approach collects data from the field and harnesses it to **support intelligent decision-making**. For instance: obtaining real-time data on nutrient status in the field from NPK (Nitrogen Phosphorous and Potassium) sensors, alongside crop monitoring data and hyper-local weather that would allow you to **make completely objective risk-based decisions on when and where to apply fertiliser**. We know the industry is taking this proposition seriously – our own research told us that on average agriculture respondents expect to spend close to $1million on IoT solutions in the next three years and 72% of respondents would use satellite technology to support their projects. Of course, satellite isn’t the answer to everything and should be used in tandem with other connectivity types, and the good news is it’s easy to integrate with other connectivity technologies. With increasing demand to connect the physical world to the digital world, in some of the world’s remotest locations think of satellite not just as a series of images taken from space but an enabler to the Agri-Tech Revolution.

**Food shortages go nuclear.**

**FDI 12** [FDI; a Research institute providing strategic analysis of Australia’s global interests; citing Lindsay Falvery, PhD in Agricultural Science and former Professor at the University of Melbourne’s Institute of Land and Environment (Future Directions International, , “Food and Water Insecurity: International Conflict Triggers & Potential Conflict Points,”<http://www.futuredirections.org.au/workshop-papers/537-international-conflict-triggers-and-potential-conflict-points-resulting-from-food-and-water-insecurity.html>] brett

There is a **growing appreciation** that the conflicts in the next century will **most likely** be fought over a lack of resources. Yet, in a sense, this is not new. Researchers point to the French and Russian revolutions as conflicts induced by a lack of food. More recently, **Germany’s World War Two** efforts are said to have been inspired, at least in part, by its perceived need to gain access to more food. Yet the general sense among those that attended FDI’s recent workshops, was that the scale of the problem in the future could be **significantly greater** as a result of population pressures, changing weather, urbanisation, migration, loss of arable land and other farm inputs, and increased affluence in the developing world. In his book, Small Farmers Secure Food, Lindsay Falvey, a participant in FDI’s March 2012 workshop on the issue of food and conflict, clearly expresses the problem and why countries across the globe are starting to take note. . He writes (p.36), “…if people are hungry, especially in cities, **the state is not stable** – riots, violence, breakdown of law and order and migration result.” “Hunger feeds anarchy.” This view is also shared by Julian Cribb, who in his book, The Coming Famine, writes that if “large regions of the world run short of food, land or water in the decades that lie ahead, then **wholesale, bloody wars are liable to follow**.” He continues: “An increasingly credible scenario for **World War 3** is not so much a confrontation of super powers and their allies, as a **festering, self-perpetuating chain of resource conflicts**.” He also says: “The wars of the 21st Century are less likely to be global conflicts with sharply defined sides and huge armies, than a scrappy mass of failed states, rebellions, civil strife, insurgencies, terrorism and genocides, sparked by bloody competition over dwindling resources.” As another workshop participant put it, people do not go to war to kill; they go to war over resources, either to protect or to gain the resources for themselves. Another observed that hunger results in passivity not conflict. Conflict is over resources, not because people are going hungry. A **study** by **the I**nternational **P**eace **R**esearch **I**nstitute indicates that where food security is an issue, it is more likely to result in some form of conflict. **Darfur, Rwanda, Eritrea and the Balkans** experienced such wars. Governments, especially in developed countries, are increasingly aware of this phenomenon. The UK Ministry of Defence, the CIA, the US **C**enter for **S**trategic and **I**nternational **S**tudies and the Oslo Peace Research Institute, **all identify** famine as a potential trigger for conflicts and possibly even **nuclear war**.