## 1

#### I: Appropriation means controlling property rights in the context of space law.

* The definition is from Black’s Law Dictionary

Su 17 [Jinyuan Su, Professor and Assistant Dean at Xi'an Jiaotong University School of Law, China, “Legality of unilateral exploitation of space resources under international law,” 2017, *International & Comparative Law Quarterly*, Vol. 66, Issue 4, pp. 991-1008, https://doi.org/10.1017/S0020589317000367, EA]

The Outer Space Treaty does not prohibit expressis verbis the extraction of space resources. However, there exists a possibility that the recognition of property rights by a State, which is a party to the Outer Space Treaty, over resources extracted in outer space may conflict with its international obligations under Article II of the treaty, which proscribes the national appropriation of outer space 'by claim of sovereignty, by means of use or occupation, or by any other means'.26 The term 'appropriation' means '[t]he exercise of control over property; a taking of possession'.27

#### V: Satellite positioning is de facto appropriation, not appropriation proper.

Matignon 19 [Louis de Gouyon Matignon, PhD in space law from Georgetown University, “ORBITAL SLOTS AND SPACE CONGESTION,” 06/03/19, *Space Legal Issues*, https://www.spacelegalissues.com/orbital-slots-and-space-congestion/, EA]

Near-Earth space is formed of different orbital layers. Terrestrial orbits are limited common resources and inherently repugnant to any appropriation: they are not property in the sense of law. Orbits and frequencies are res communis (a Latin term derived from Roman law that preceded today’s concepts of the commons and common heritage of mankind; it has relevance in international law and common law). It’s the first-come, first-served principle that applies to orbital positioning, which without any formal acquisition of sovereignty, records a promptness behaviour to which it grants an exclusive grabbing effect of the space concerned. Geostationary orbit is a limited but permanent resource: this de facto appropriation by the first-comers – the developed countries – of the orbit and the frequencies is protected by Space Law and the International Telecommunications Law. The challenge by developing countries of grabbing these resources is therefore unjustified on the basis of existing law. Denying new entrants geostationary-access or making access more difficult does not constitute appropriation; it simply results from the traditional system of distribution of access rights. The practice of developed States is based on free access and priority given to the first satellites placed in geostationary orbit.

#### Vote neg –

#### 1 – Limits – they allow banning practices that don’t constitute taking property rights, but do preclude other actors from using the same space – opens the door to almost any practices like mining because those stop other actors from doing the same thing.

#### 2 – Ground – basing appropriation off use instead of ownership kills our DA links based off property rights – think mining good and other private sector good turns. Key on a topic with zero neg generics.

#### Drop the debater – abusive advocacies skew substance – 1AR restart doesn’t check 1NC construction.

#### Competing interps – offense proves they’re not reasonable and anything else encourages arbitrary judge intervention.

#### No RVIs – leads to baiting T and chilling checks on abusive AFFs – causes substance crowdout.

## 2

### 1NC – Africa DA

#### LEO is uniquely accessible to African industry due to cheaper launch and production costs – that solves Earth Observation, internet, national security, and spills over to enrich the economy

Samanga 21 Ruvimbo Samanga, Zimbabwean scholar and lawyer working with the Space Law & Policy, holds a BA Law (cum laude), an LLB and an LLM in International Trade and Investment Law from the University of Pretoria. "Why Africa Should Expand its Mega-Satellite Constellation Capacity." Space Legal Issues, 3 May. 2021, www.spacelegalissues.com/why-africa-should-expand-its-mega-satellite-constellation-capacity.

Since 1988, Africa has spent approx. USD$4 billion towards the launch of 41 satellites (excluding the cost of the RASCOM-QAF 1R replacement). 30 of these satellites fall into the Small Satellite market. The majority of satellites owned by African institutions typically involves satellites with less than 600kgs in fueled mass and 24 of these satellites have less than 200kg fueled mass. The reason for the interest in the miniaturized satellites? In a nutshell, they offer cheaper design alternatives, coupled with the ease of mass production. They are also significantly more versatile in certain applications, owing to their reduced size. For example, they are the satellite of choice for low data rate communications, being launched in large multi-coverage constellations in Low Earth Orbit (LEO). It comes as no surprise then that small satellites are growing increasingly popular amongst developing countries, no less within the region, for the accessibility. The growth of the small satellite industry is evident in commercial as well as large programs which exhibit steady growth. In 2019, 5 African countries launched 8 satellites, 6 of which were small satellites. It is expected that by the year 2024, 19 African countries would have launched additional satellites into space. These small, sometimes called nano-satellites, are really driving the African space program, especially in line with the African Union’s (AU) science and technology ambitions which are expected to reap huge benefits for the continent. Most importantly through the AU Science, Technology and Innovation Science Strategy for Africa – 2024 (STISA-2024). Small satellites are categorized as space systems of up to 600 kg (falling into the categories of Minisatellites, Microsatellite, Nanosatellite, Picosatellite, and Femto Satellites). They range across different applications (Satellite Communications, Imaging & Earth Observations, Space Situational Awareness, and Technology Development), and have different end users (Government & Defense, and Civil & Commercial). Of the 8 satellites launched in 2019, 6 were small satellites (3 Nanosatellites, 2 Microsatellites, and 1 Picosatellite). Satellite communications mega-constellations are on the rise, however this growing interest is not without its challenges and uncertainties. The biggest risks in the small sat interest in the coming years are mostly ascribed to investor’s rick assessment & funding availability; Securing customers & Return on Investment (ROI); Stronger regulations; Competition from heavier satellite, and reliability. This is also further compounded by the fact that establishing a satellite service industry which is sustainable requires adequate funding. Skillset deficit is also a prominent challenge. Even though Africa has and will in future have the largest population of young people, the youth are generally not interested in pursuing careers in STEM (science, technology, engineering and mathematics). You can expect more satellites to be launched despite these crises. As regards the African Small Sat market, the growth perspectives seem to point towards predominant university projects which demonstrates a capacity to operate Smallsats, also attesting to the affordability of the systems. This is also a sign of government effort to support the growth of this industry, and the contributions of the youth in satellite development. Indeed the manufacturing ability is extremely important, but also the service capability and development prospects. Despite these positive steps there is still quite a need for funding in this area. Of the overall revenue and results, Earth Observation is the most predominant small sat use, however it is expected in the next few years this may shift to internet broadband, but ultimately, creating value for users and enabling services that drive industry development will be the ultimate determining factor. Internet coverage allows people to create capacity and this might undoubtedly be Africa’s most prolific use of small satellite solutions. CubeSats which are around 50 kg, are the most popular and are only getting bigger because of the interest for carrying larger payloads. But in future it may become less stringent to use the restricted platform, but the threshold is bound to switch to a smaller regular platform. These services are enabled through satellite mega-constellations. Satellite mega-constellations operate in the Lower Earth Orbit which is described as the orbit located no more than 2,000 kilometers from the Earth’s surface. There is room for LEO regarding low-latency connectivity. But this does not mean that the Geostationary Orbit will become redundant, rather, and on the other hand GEO will remain an asset for broadband, because of its efficiency and coverage as well as less-sophisticated ground segments. Nevertheless, the LEO offers the most advantageous orbital resource to come and deserves much policy intervention to regulate, owing to the fact that it is a finite, scare resource. At the end of the day, whether Smallsats are launched in a constellation or as individual space systems, they offer a cost-effective alternative to traditional space objects, and would allow Africa the opportunity to release its potential in various areas of interest including but not limited to communications, global positioning and navigation, and Earth observation. Africa would be enriched by the ability to use this new technology to enable users through diverse services, to protect assets within the value chain, or simply to monitor areas of national security such as the environment and borders. These are all aspects which will have a substantial developmental impact in the African economy, and is well aligned to the African space policy which speaks towards increase of space and satellite capacity in an affordable and beneficial manner.

#### LEO Earth Science Observation Satellites uniquely solve a host of environmental threats – pollution, climate change, biod, defo, soil erosion

Ustin and Middleton 20 Ustin, S.L. [John Muir Institute of the Environment, University of California, Davis] , Middleton, E.M [NASA/Goddard Space Flight Center (Emerita)]. Current and near-term advances in Earth observation for ecological applications. Ecol Process 10, 1 (2021). https://doi.org/10.1186/s13717-020-00255-4

There is an unprecedented array of new satellite technologies with capabilities for advancing our understanding of ecological processes and the changing composition of the Earth’s biosphere at scales from local plots to the whole planet. We identified 48 instruments and 13 platforms with multiple instruments that are of broad interest to the environmental sciences that either collected data in the 2000s, were recently launched, or are planned for launch in this decade. We have restricted our review to instruments that primarily observe terrestrial landscapes or coastal margins and are available under free and open data policies. We focused on imagers that passively measure wavelengths in the reflected solar and emitted thermal spectrum. The suite of instruments we describe measure land surface characteristics, including land cover, but provide a more detailed monitoring of ecosystems, plant communities, and even some species then possible from historic sensors. The newer instruments have potential to greatly improve our understanding of ecosystem functional relationships among plant traits like leaf mass area (LMA), total nitrogen content, and leaf area index (LAI). They provide new information on physiological processes related to photosynthesis, transpiration and respiration, and stress detection, including capabilities to measure key plant and soil biophysical properties. These include canopy and soil temperature and emissivity, chlorophyll fluorescence, and biogeochemical contents like photosynthetic pigments (e.g., chlorophylls, carotenoids, and phycobiliproteins from cyanobacteria), water, cellulose, lignin, and nitrogen in foliar proteins. These data will enable us to quantify and characterize various soil properties such as iron content, several types of soil clays, organic matter, and other components. Most of these satellites are in low Earth orbit (LEO), but we include a few in geostationary orbit (GEO) because of their potential to measure plant physiological traits over diurnal periods, improving estimates of water and carbon budgets. We also include a few spaceborne active LiDAR and radar imagers designed for quantifying surface topography, changes in surface structure, and 3-dimensional canopy properties such as height, area, vertical profiles, and gap structure. We provide a description of each instrument and tables to summarize their characteristics. Lastly, we suggest instrument synergies that are likely to yield improved results when data are combined. Background Many environmental scientists have concluded that the Earth is at or near one or more perilous climate tipping points (Krieger et al. 2009; Lenton, 2011, Lenton and Williams 2013; Brook et al. 2013; Hickman et al., 2019). Climate change interacts with and exacerbates many other environmental and societal problems. These include air and water pollution that compound health issues (Harlan and Ruddell 2011; Kan et al. 2012), especially in poor communities (Schlosberg and Colins 2014; Hallegatte and Rozenberg 2017), widespread and/or frequent droughts linked to extensive fires (Amiro et al. 2001; Littell et al. 2016), diminished resources for drinking water and irrigation (Jackson et al. 2001; Oki and Kanae 2006), and large-scale biodiversity losses (Lindenmayer and Likens 2011; Pires et al. 2018) , including species extinctions (Cahill et al. 2013). Related factors include deforestation (Green and Sussman 1990) and soil erosion (Hill et al., 2009, consequences of over-exploitation of resources (Giri et al. 2007) due to massive global conversion of natural resources for human uses (Seto et al. 2002. Documentation of all of these problems and many others are of interest to the broader ecological community at scales from local to global. This can only realistically be accomplished with satellite observations in combination with process and statistical models to reveal patterns and trends that enlighten understanding about how current conditions have developed from past environmental drivers in order to predict future conditions.

#### Warming causes extinction

David **Spratt 19**, Research Director for Breakthrough National Centre for Climate Restoration, Ian Dunlop, member of the Club of Rome, formerly an international oil, gas and coal industry executive, chairman of the Australian Coal Association, May 2019, “Existential climate-related security risk: A scenario approach,” https://docs.wixstatic.com/ugd/148cb0\_b2c0c79dc4344b279bcf2365336ff23b.pdf

An existential risk to civilisation is one posing **permanent large negative consequences** to humanity which may never be undone, either **annihilating intelligent life** or permanently and drastically curtailing its potential.

With the commitments by nations to the 2015 **Paris** Agreement, the current path of warming is 3°C or more by 2100. But this figure does not include “long-term” **carbon-cycle feedbacks**, which are materially relevant now and in the near future due to the **unprecedented** **rate** at which human activity is perturbing the climate system. Taking these into account, the Paris path would lead to around 5°C of warming by 2100.

Scientists warn that warming of 4°C is incompatible with an organised global community, is **devastating** to the **majority of** **ecosystems**, and has a **high probability** of not being stable. The World Bank says it may be “**beyond adaptation**”. But an existential threat may also exist for many peoples and regions at a significantly lower level of warming. In 2017, 3°C of warming was categorised as “catastrophic” with a warning that, on a path of unchecked emissions, low-probability, high-impact warming could be catastrophic by 2050.

The Emeritus Director of the Potsdam Institute, Prof. Hans Joachim Schellnhuber, warns that “climate change is now reaching the **end-game**, where very soon humanity must choose between **taking** **unprecedented action**, or accepting that it has been left too late and **bear** **the consequences**.” He says that if we continue down the present path “there is a very big risk that we will just **end** **our** **civilisation**. The human species will survive somehow but we will destroy almost everything we have built up over the last two thousand years.”11

Unfortunately, conventional risk and probability analysis becomes useless in these circumstances because it excludes the full implications of outlier events and possibilities lurking at the fringes.12

Prudent risk-management means a tough, objective look at the real risks to which we are exposed, especially at those **“fat-tail” events**, which may have consequences that are damaging beyond quantification, and **threaten** **the** **survival** **of human** **civilisation**.

Global warming projections display a “fat-tailed” distribution with a **greater likelihood** of warming that is well in **excess of** **the** **average amount** **of warming** **predicted by** **climate** **models**, and are of a higher probability than would be expected under typical statistical assumptions. More importantly, the risk lies disproportionately in the “fat-tail” outcomes, as illustrated in Figure 1.

#### Independent African satellite constellation key to push out foreign, Chinese investment – which kills African democracy

Tuerk 20 Tuerk, Miriam. CEO and cofounder of Clear Blue Technologies Inc."Africa Is The Next Frontier For The Internet." Forbes, 8 June 2020, www.forbes.com/sites/miriamtuerk/2020/06/09/africa-is-the-next-frontier-for-the-internet/?sh=1f5e9eec4900.

Expanding network connectivity across sub-Saharan Africa will open up digital services that many of us now take for granted. Mobile Banking, Whatsapp Chatting and video, e-health, e-education are key services only possible with reliable internet connectivity. For a geographically disparate population, it will mean greater access to essential services, including e-agri services. There are hugely populous cities in sub-Saharan Africa – Lagos in Nigeria is one of the fastest growing cities in the world – but even in the center on Victoria Island, the internet connection can be patchy and face frequent outages. For those populations, access to the internet means being able to save, invest and borrow money, getting an education, having access to basic healthcare, and being able to trade with bigger markets; are all fundamental to socioeconomic advancement. That has been a powerful force fueling economic growth over the past century across Europe, North America and Asia. The Demand Is There There is a lot of pent-up demand for internet services in sub-Saharan Africa. Indeed, a substantial portion of mobile phones have internet and messaging capabilities. Mobile usage in sub-Saharan is more widespread than electricity – in 2016, The Economist found that while less than half the population has access to electricity, two-fifths own a mobile phone. In a Pew Research survey of six sub-Saharan Africa countries, a median of 41% used the internet occasionally or had access to an internet-capable smartphone – that compares to 89% of Americans. Digital innovations have also taken off quickly in sub-Saharan Africa, partly because the younger demographic is more ready for adoption of new technologies. Compared to aging populations in developed countries, the median age in Africa is 19.2 years old. In a study by Pew Research, it notes that adults younger than 30 in six sub-Saharan African countries are more likely to use the Internet, echoing trends seen elsewhere. We’ve seen this in the quick adoption of digital technologies. Safaricom, Kenya’s largest telecom operator, has seen widespread adoption of its mobile payment app, M-Pesa, since it was launched in 2007. The app now has 24.5 million users, representing over 70% of the mobile money market in Kenya, and can be used to send and receive funds via SMS without having a bank account. The Supply Is Growing, But Still Faces Bottlenecks There are a number of mobile carriers now seeking to expand network coverage in Africa, especially in rural areas. Governments are pushing for these infrastructure roll outs as they recognize that communications and renewable energy are two key tenets of development for their countries. Telecom technology over the past decade has advanced significantly, with specialized product development to address the needs of Rural telecom particularly in terms of the off-grid renewable energy, resilience to extreme temperatures, and software driven base stations meaning that masts can placed almost anywhere. The wider need for infrastructure development in telecom and renewable energy is well recognized. The African Development Bank (AfDB) estimates that the continent of Africa will need investment of at least US$130 billion to $170 billion annually. In recent years, the majority of that capital investment into African infrastructure has come from China – foreign direct investment from China has grown 40% annually over the past decade, and it could be even higher, dwarfing investment from other economic partners, including the U.S. ZAMBIA CHINA A pedestrian runs past a Huawei Technologies Co. mural painted on a wall in Lusaka, Zambia, on ... [+] © 2018 Bloomberg Finance LP Huawei, ZTE and China Telecom CHA 0.0% have all made in-roads into the region. Huawei recently announced that it was launching a 5G transport network with Rain in South Africa, the first network operator in the country to deploy 5G. Huawei’s growth in the region has raised concerns that it could be used for surveillance; The Wall Street Journal reported last year that technicians from the company helped African governments to spy on their political opponents. At the same time, Western companies such as Vanu and Parallel Wireless are developing innovative solutions and products. While growth in technology is overall a good thing for society, it cannot come at the cost of democracy. Western governments need to do more to invest in African telecoms to secure the future of this region and our economic relationships with it.

#### expansion in Africa escalates absent democratic relations

Maru 19 - a scholar of peace and security, law and governance, strategy and management, human rights and migration issues. (Mehari, “A new cold war in Africa” Aljazeera. July 1, 2019. DOA: November 17, 2019. https://www.aljazeera.com/indepth/opinion/cold-war-africa-190630102044847.html)//MGalian

Increasing tensions between China and the US will be detrimental to African prosperity and peace. Last week, the 12th US-Africa Business Summit, a high-level event attended by 11 African heads of state and government and some 1,000 business leaders, was held in Maputo, Mozambique. During the three-day event, US officials unveiled a $60bn investment agency which will seek to invest in low and middle-income countries, with a special focus on Africa. The announcement came six months after National Security Advisor John Bolton presented the Trump administration's "New Africa Strategy". According to the document: "Great power competitors, namely China and Russia, are rapidly expanding their financial and political influence across Africa. They are deliberately and aggressively targeting their investments in the region to gain a competitive advantage over the United States." Although both China and Russia are mentioned, over the past few months, the US has demonstrated that it is mainly concerned about the former. In fact, it already appears that Africa is set to become yet another battleground for the escalating trade war between Beijing and Washington. With increasing foreign military presence and growing diplomatic tensions, the continent is already witnessing the first signs of an emerging new cold war. And just like the previous one devastated Africa, fuelling wars and forcing African governments to make economic choices not in their best interests, this one will also be detrimental to African development and peace. Economic war China's approach to Africa has always been trade oriented. The continent became one of the top destinations for Chinese investment after Beijing introduced the so-called "Go Out" policy in 1999 which encouraged private and state-owned business to seek economic opportunities abroad. As a result, Chinese trade with Africa has increased 40-fold over the past two decades; in 2017, it stood at $140bn. Between 2003 and 2017, Chinese foreign direct investment (FDI) flows have also jumped more close to 60-fold to $4bn a year; FDI stocks stand at $43bn - a significant part of which has gone to infrastructure and energy projects. China has significantly expanded African railways, investing in various projects in Kenya, Ethiopia, Djibouti, Angola and Nigeria; it is currently building a massive hydropower plant in Angola and have built Africa's longest railway connecting Ethiopia and Djibouti; it has built the headquarters of the African Union in Addis Ababa and the West African regional bloc ECOWAS in Abuja. By contrast, for a long time the US has viewed Africa as a battlefield where it can confront its enemies, whether the Soviets during the Cold War, terrorists after 9/11 or now the Chinese. Washington has never really made a concerted effort to develop its economic relations with the continent. As a result, trade between the US and Africa has decreased from $120bn in 2012 to just over $50bn today. US FDI flows have also slumped from $9.4bn in 2009 to around $330m in 2017. The new $60bn investment fund announced last week is a welcome initiative from the US but it will not be able to challenge Chinese economic presence on the continent. Just last year Chinese President Xi Jinping pledged $60bn too but dedicated it solely to investment in Africa. The US has repeatedly accused China of using "debt to hold states in Africa captive to [its] wishes and demands" and has warned African states to avoid Chinese "debt diplomacy" which is supposedly incompatible with the independence of African nations and civil society and poses "a significant threat to US national security interests". Yet, Africa is only the fourth-biggest recipient of Chinese FDI after Europe (mainly Germany, UK and Netherlands), the Americas (mainly the US and Canada), and Asia. The US has also borrowed heavily from China; currently its debt to its rival stands at $1.12 trillion. By contrast, Africa owes China around $83bn. Africans are fully aware of and concerned about high indebtedness, trade imbalances, the relatively poor quality of Chinese goods and services and Beijing's application of lower standards of labour and environmental practices. But many do not share the American perspective that their economic relationship with China is to their detriment and rather see it as an opportunity that provides much-needed unconditional funding and that takes into account local priorities. As Djibouti's President Ismail Omar Guelleh has pointed out, "The reality is that no one but the Chinese offers a long-term partnership." The pressure the US is currently exerting on African countries to move away from partnerships with China could hurt African economies. It could force African countries into making choices that are not in their best economic interests and miss out on important development projects or funding. Meanwhile, the US-China trade war is already affecting the continent. According to the African Development Bank, it could cause as much as a 2.5 percent decrease in GDP for resource-intensive African economies and a 1.9 percent dip for oil-exporting countries. Militarisation The escalating tensions between the US and China could also end up threatening the security of the continent**.** Both countries are militarily involved in Africa. Over the past 15 years, the Chinese People's Liberation Army has been engaged in a number of security missions across the continent, making modest auxiliary troop contributions to peacekeeping operations in Sudan, South Sudan, Liberia, Mali and the Democratic Republic of Congo. It has also contributed millions of dollars of peacekeeping equipment to the African Union Mission in Somalia and provided significant funding to the Intergovernmental Authority on Development for its mediation in South Sudan. In 2017, the first Chinese overseas military base was opened in Djibouti. The facility, which currently hosts some 400 staff and troops, and has the capacity to accommodate 10,000, is officially supposed to provide support for the ongoing anti-piracy operations of the Chinese navy, but it also plays a role in securing maritime routes, part of the Belt and Road Initiative. There has also been speculation that this is the first of a number of planned bases meant to secure Chinese interests in Africa. China's military presence in Africa, however, pales in comparison to that of the US. Over the past few years, US Africa Command has run some 36 different military operations in 13 African countries, including Burkina Faso, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Kenya, Libya, Mali, Mauritania, Niger, Somalia, South Sudan and Tunisia. It has more than 7,000 troops deployed on the continent. It has a large base in Djibouti - the biggest and only permanent US military base in Africa - but it also runs at least 34 other military outposts scattered across the west, east and north of the continent where US troops are deployed and military operations (including drone attacks) are launched from. The US also directly supports the armies of Egypt, Nigeria, Ethiopia, Mali, Niger and others as well as the G5 Sahel force tasked with counterterrorism. While a direct confrontation between US and Chinese forces in Africa is unlikely, their growing presence is becoming an increasingly destabilising factor. Already Washington's strategy to contain Chinese influence over Africa is playing out at different conflict and social upheaval hotspots across the continent. The fallout of the US-Chinese competition is particularly apparent in the strategic Red Sea region, through which passes one of the most important maritime routes. Countries in the region are not only feeling growing US and Chinese pressure to take one side or the other, but are also increasingly exposed to outside interference by various regional powers. Growing regional tensions Djibouti has recently found itself at the centre of US-Chinese diplomatic confrontation. Being a host to military bases of both superpowers, the small country has had to play a difficult balancing game. In 2018, Djibouti seized control of its Doraleh Container Terminal from the Emirati company DP World, claiming its operation of the facility was threatening its sovereignty. The Djibouti authorities had feared that the UAE's investment in the nearby Port of Berbera in the autonomous Somali region of Somaliland could challenge its position as the main maritime hub for Ethiopia's large economy. Its decision to terminate the contract with DP World, however, triggered a sharp reaction from Washington, a close Emirati ally. The Trump administration fears that Djibouti could hand over control of the terminal to China. Bolton has warned: "Should this occur, the balance of power in the Horn of Africa - astride major arteries of maritime trade between Europe, the Middle East, and South Asia - would shift in favour of China. And, our US military personnel at Camp Lemonnier could face even further challenges in their efforts to protect the American people." Djibouti was forced to declare publicly that it would not allow China to take over the terminal but that has not assuaged US fears. Ever since, the US sought to secure a possible alternative location for its African military base: neighbouring Eritrea. It encouraged regional actors, including Saudi Arabia and the UAE, to pull Eritrea out of its decades-long isolation. In a matter of months, long-time enemies Ethiopia and Eritrea concluded a peace agreement to end their 20-year-old cold conflict, while the UN lifted sanctions on Asmara. As a result, Eritrea could emerge as a strategic rival to Djibouti, offering its coast for foreign military and economic facilities. The UAE, for example, has already set up a military base near the port of Assab. Sudan, to the north, has also been the battleground of the ongoing superpower turf war. China had been a long-term supporter of President Omar al-Bashir. Under his rule, Beijing came to dominate its oil industry, buying some 80 percent of its oil and thus providing Khartoum with much-needed cash to wage war against various rebel groups. It was also one of the few countries, along with Russia, that would break the UN arms embargo and sell weapons to al-Bashir's regime. After South Sudan gained independence in 2011, China continued to be a close partner of the Sudanese regime, remaining its main trading partner. Sudan in fact became the biggest beneficiary of the $60bn Africa investment package China pledged in 2018, having some $10bn in Chinese debt written off. The Chinese government also made a lot of plans to develop facilities in Port Sudan, where it already operates an oil terminal. Qatar and Turkey also signed deals with al-Bashir for various facilities in the port city. When mass protests erupted in December last year, Beijing stood by al-Bashir, who it saw as the main guarantor of stability in the country, which falls on strategic routes, part of its Belt and Road Initiative. Meanwhile, the US had repeatedly demonstrated that it did not want al-Bashir running for another term. His removal was approved in Washington, which has since appeared to back the interests of Saudi Arabia and the UAE in the country. The two Gulf states currently hope to install another strongman sympathetic to their regional politics, who would maintain Sudan's participation in the war in Yemen and curb Turkish and Qatari influence. At this point, it seems China is at risk of being sidelined by the significant sway the UAE and Saudi Arabia have with Sudan's Transitional Military Council (TMC). Apart from Djibouti and Sudan, various other countries in the region have felt the consequences of the US bid to contain China. This political confrontation has also added to the already rising tensions between other players in the region, including Egypt, Gulf countries, Iran and Turkey. The Trump administration has particularly favoured Emirati, Saudi and Egyptian interests which have emboldened these three countries in their efforts to shape regional dynamics to their advantage. Thus, in the long-term, given the pre-existing faultlines and conflicts in the region, the US-China cold war could have a detrimental effect, not only on its economy but also on its security. At this point, to preserve its interests and its peace, Africa has only one option: to reject pressures to swear allegiance to either of the two powers. African countries should uphold their sovereignty in policy and decision-making and pursue the course that is in the best interests of their nations. If the US wants to compete with China on the continent, it should do so in good faith. It can gain a competitive advantage by offering African countries better, more credible and principled alternatives to those put forward by China. But that can only happen if the US develops a strategy that focuses on Africa itself, not on containing and undermining the business of a third party.

## 3

Text: States except for Africa ought to prohibit the appropriation of Low Earth Orbit by private entities

* Solves the net benefits of the plan because they don’t specify that African satellites are bad
* Solves net benefit of the disad too

## 4

#### Text: States ought to:

#### • amend the Outer Space Treaty to create a private property regime that grants exclusive rights to private entities to exploit resources within space facilities and a safety zone of 1000 meters if they inhabit, maintain and/or operate said facility for a period of at least one year conditional upon peaceful use of the property;

#### • establish an international space debris organization modelled off the International Civil Aviation Organization that is granted exclusive and mandatory standard-setting authority over space debris;

#### • mandate a transition to zero-emissions modes of transportation;

#### • ban the use of environmentally harmful housecleaning products;

#### • ban ozone-depleting pesticides;

#### • ban nitrous oxide.

#### Plank 1 solves and preserves legal certainty.

Brehm 15 [Andrew R. Brehm, attorney at the law firm Scopelitis Garvin, “Private Property in Outer Space: Establishing a Foundation for Future Exploration,” 2015, *Wisconsin International Law Journal*, Vol. 33, Issue 2, https://repository.law.wisc.edu/s/uwlaw/media/77012, EA]

International agreement is essential to establishing a system of private property rights in outer space for the simple reason that outer space does not belong to one single nation; it is not the prerogative of the US government, or any government, to implement unilateral legislation that would significantly alter outer space and the current space law framework. It would frustrate the common conception of outer space as a free and open place, as well as the current legal framework, to simply enact domestic legislation that allows for the acquisition of private property rights in outer space. A collaborative, international approach is necessary for legal and practical reasons, in order to successfully establish an effective and beneficial system of private property rights in outer space.

Wayne White’s treaty proposal creates a strong foundation for international discussion of the increasingly important issue of private property acquisition in outer space. White’s well-crafted treaty proposal seeks to advance private exploration of outer space within the regulatory framework of the Outer Space Treaty and existing international space law. By creating a system in which private entities can establish real property rights in their space objects and a surrounding safety zone, the proposal incentivizes private investment of large sums into space exploration programs. Provisions which authorize the right to exclude, the right to be free from interference, the exclusive right to appropriate resources within an established safety zone, and the right to sell real property further encourage private space exploration and create strong associated incentives. 107 Private space exploration and resource extraction entities allocate substantial investments in furtherance of their space programs. 108 Allowing such entities to mine valuable platinum group resources, as well as water and hydrogen in celestial bodies that can be used to propel deeper space exploration, not only provides a robust safety net for current space exploration entities, but also creates a system that encourages new entities to enter into the field of private space exploration. Increased space exploration across the board would have nearly unlimited benefits in terms of societal, economical, and technological advancement. 109

Additionally, an international agreement alleviates some of the general concerns associated with establishing private property rights in outer space. Outer space is generally viewed as a place that should be open to all for free and peaceful use. 110 Opponents of private property rights in outer space often cite concerns about over-allocation of property at the exclusion of non-spacefaring nations or entities, and associated concerns. " 1 White’s proposed international agreement alleviates these concerns by placing limitations on which real property rights can be acquired.

First, under the proposal for an international agreement, private entities are entitled to formal recognition of property rights if they “inhabit, maintain and/or operate a space facility for a period of at least one year.” 112 This overcomes the potential issue of modern-day private colonialism where private entities could simply stake their company flags and claim ultimate title to the property. Of course, the duration requirement could be extended and additional requirements for formal recognition of property rights could be attached. Additionally, the property rights under White’s system would only apply to space facilities and a safety zone of either 500 or 1,000 meters surrounding a space facility.113 This limitation avoids concerns of over-allocation of private property in space. Essentially, private entities would not be capable of acquiring private property rights to vast amounts of territory. Also, property rights of private entities would immediately terminate if the property is used for non-peaceful purposes, if it is abandoned for an extended period of time, or if it used to prevent free access to outer space or celestial bodies114 These provisions ensure that outer space will be used for peaceful purposes and will remain open for free exploration.

Ultimately, a well-crafted international agreement similar to White’s proposal creates a system of private property rights in outer space that remains true to the overarching goals of outer-space exploration. Such a system would incentivize private space exploration in a realistic and pragmatic fashion that benefits all mankind. If peaceful and free space exploration is a desirable goal, White’s treaty proposal lays a strong foundation. This foundation has the potential to lead to an effective international system that addresses modem space exploration concerns while facilitating future development in the arena of space exploration.

#### Plank 2 solves debris.

Larsen 18 [Paul B. Larsen, taught air and space law for more than forty years respectively at Southern Methodist University and at Georgetown University, “Solving the Space Debris Crisis,” 2018, *Journal of Air Law and Commerce*, Vol. 83, Issue 3, https://scholar.smu.edu/cgi/viewcontent.cgi?article=4092&context=jalc, EA]

D. OPTION OF AN INTERNATIONAL SPACE DEBRIS ORGANIZATION

1. ICAO Analogy Option

An international space debris organization capable of establishing international mandatory standards for old as well as for new space debris would require new decision-making authority. One model for such an organization could be the ICAO, which is a sub-agency of the United Nations. ICAO’s main purpose is to establish international standards and procedures for air traffic that are mandatory and uniform.153 The authorizing treaty is the 1944 Chicago Convention.154 Its Article 37 establishes ICAO’s standard-setting functions for civil aviation.155 Article 56 provides for the creation of the ICAO Air Navigation Commission, which is a standing commission of nineteen experts.156 Its function is to draft standards and to continuously update existing standards as needed by new developments.157 The technical experts do not represent states and are therefore not beholden to specific states. The Commission has subcommittees on specific subjects. In their examinations, the experts solicit contributions from private operators, users, and air services, as well as from states. The standards are agreed to by the Air Navigation Commission and submitted to the ICAO Council for approval, after which the standards are submitted to the ICAO member states. At that point in time the individual states have the option of filing deviations from the international standards.158 The standards apply only to civil users.159 Military operators tend to observe the civil standards for the sake of uniformity and safety.

a. Strengths

Focusing decision-making on international standards and procedures for all kinds of space debris would remove the decision-making from all the other many issues that are now discussed in COPUOS. If the ICAO model were adopted, then an expert technical commission would be charged with examination of the technical and physical ways of best limiting and removing debris. The commission would not be distracted by political issues as COPUOS is now. The decision-making would take place in a UN forum. It would not be dependent on an outside group like the IADC. The standards and procedures developed by a space debris commission would become mandatory upon approval by a small space debris council and only subject to deviations by individual states for good cause. States would appreciate the safety and navigation advantages of uniform international space debris rules. Decision-making would be expedited because the space debris commission would only be motivated by the urgency of the need for space debris regulation. As in ICAO, the space debris standards and procedures would establish the minimum requirements with states free to create more comprehensive rules. The individual states would implement and enforce the space debris standards and procedures, subject to oversight by a new international space debris organization. It would be a small UN sub-agency with universal participation and decision-making powers, similar to ICAO. The ICAO model has certainly worked for commercial aviation. Applied to space traffic, the aim would be an ICAO-like transparency, certainty, and reliability.

b. Weaknesses

The weakness of adopting the ICAO model would be that it is very difficult for states to adopt a new framework. However, major devastating collisions, like a destructive collision with the International Space Station or cascades of collisions caused by cascades of debris would convince the world of the need for drastic action.160 Such collisions in outer space will happen. The wise choice would be to adopt new regulation before the big collisions happen. Another weakness is that there would be additional costs because the ICAO model would require more technology and operations. Finally, the major problem with this option would be the difficulty of organizing and adopting new international law on space debris regulation. Unfortunately, that may happen after major outer space collisions and the consequent urgency to remedy the debris problem that would follow a disaster.

c. Evaluation: Option of Using the ICAO Model for Space Debris Regulation161

It is generally agreed that the space debris problem is universal. It requires action and decisiveness for its resolution. ICAO is constantly faced with resolving aviation safety issues and regulating air space. ICAO, as a UN sub-agency, is within the UN umbrella of specialized agencies. Space has similarities to air space. Most of air space is not sovereign. Outer space is also not sovereign. ICAO has proven successful in organizing and resolving joint use of air space by all the states. Using the ICAO model to form a similar world safety organization for outer space debris should be considered. ICAO regulations are mandatory and uniform. International space debris regulations also need to be mandatory and uniform. ICAO regulation is accepted and even appreciated by military users as being of a technical nature. A similar arrangement should work for space debris regulation. A commission of space debris experts would be charged with drafting international space debris regulations. The space commission would be able to constantly evaluate the success of existing regulations and be able to make adjustments and improvements as needed. The space debris commission would prepare regulations for generation of new debris. It should also establish acceptable regulations for significant removal of existing debris sufficient to stabilize, if not reduce, the existing debris accumulation.

A small representative space debris council would be formed to approve the draft regulations. The mandatory space debris regulations would be sent to states, who would be able to file necessary individual deviations as occurs with aviation standards and procedures. The council would be guided by long term policies established by an assembly of states. Such an assembly of ICAO member states meets every three years. A similar assembly would establish long term policy for the space debris organization.

For its work on new regulations, a new space navigation commission would need substantial input of information from the users of outer space about their needs, evaluations of regulations that are successful and beneficial, and their negative reaction to regulations that do not work and are too restrictive. Users of outer space should be able to contribute technology, both for mitigation of new debris and for effective ways of removing old debris. The actual implementation of the new regulations would occur through the states themselves. They and their authorized non-governmental users would have to comply with the international regulations. The burden of actual removal of old debris would fall on the states, unless states in the debris organization agree to contract out debris removal to commercial companies. New international law would be established by a diplomatic conference to authorize the space organization and to detail its duties. The organization would be funded by the member states the same way ICAO is presently funded.

#### Planks 3-6 solve ozone – rocket launches not key and every plank is an alt cause

GreenDiary n/d [Environmental News and Blog, “”How to prevent Ozone depletion (and what would happen if we don’t)” https://greendiary.com/5-ways-prevent-ozone-depletion.html]

One of the easiest ways to reduce damages caused to the ozone layer is by limiting the use of vehicles. This is because vehicular emissions eventually result in the release of smog. This in turn also damages the ozone layer causing it to deteriorate. If you are looking for ways on how to prevent ozone depletion, then you do have certain effective option. You can choose to take the public transport or use a bicycle. Another great way to restrict the use of car is by opting for Car Pooling. If you do want to use a vehicle, then it is recommended to switch to an electric or hybrid vehicle. Even better, you can opt for vehicles that run solely on solar power. Scroll to the end of the article for a list of the same.

2. Use eco-friendly household cleaning products

Usage of eco-friendly and natural cleaning products for household chores is a great way to prevent ozone depletion. This is because many of these cleaning agents contain toxic chemicals that interfere with the ozone layer. A lot of supermarkets and health stores sell cleaning products that are toxic-free and made out of natural ingredients.

3. Avoid using pesticides and prevent ozone depletion

Overuse-of-pesticides

Pesticides may be an easy solution for getting rid of weed, but are harmful for the ozone layer. The best solution for this would be to try using natural remedies, rather than heading out for pesticides. You can perhaps try to weed manually or mow your garden consistently so as to avoid weed-growth. Or else, try Urban Aerofarming, which requires less water, less space and little to no amount of pesticides. To know more about Urban Aerofarms, scroll down. You can check out the different DIY ideas to make your own eco-friendly pesticides at home to prevent ozone depletion.

4. Developing stringent regulations for rocket launches

The world is progressing at a drastic pace. As we progress on various scientific discoveries, the need of the hour also requires people to travel out of space. The number of rocket launches has increased drastically. This in turn is equally damaging the ozone layer in many ways. A study shows that the harm caused by rocket launches would outpace the harm caused due to CFCs.

At present, the global rocket launches do not contribute hugely to ozone layer depletion. Due to the advancement of the space industry, it will become a major contributor to ozone depletion. All types of rocket engines result in combustion by products that are ozone-destroying compounds that are expelled directly in the middle and upper stratosphere layer – near the ozone layer.

5. Banning the use of dangerous nitrous oxide

Ozone-Layer-DepletionIn the late 70’s the world was taken by surprise with a study that triggered a red alert pertaining to the destruction caused to the ozone layer. It had all the necessary information that helped us to understand what exactly was going on. Even the facts and figures mentioned in the study clearly pointed out towards the alarming rate of how the ozone layer was being depleted.

Nations around the globe got together in 1989 and formed the Montreal Protocol. The main aim behind this was to stop the usage of CFCs. However, the protocol did not include nitrous oxide which is the most fatal chemical that can destroy the ozone layer and is still in use. Governments across the world should take a strong stand for banning the use of this harmful compound to save the ozone layer.

6. Avoiding Ozonolysis Purifiers

Air-Purifier

Are we risking our health and environment with the development of new technology? We believe that air purifiers are an effective way to fight air pollutants but they can actually have the harmful effects, which we are not aware of.

New technology has allowed companies to make products which can “freshen” air by producing ozone which is not healthy to humans in large quantities. These ozone layers can actually react with existing particles in the air and make them more dangerous.

## Case

#### Turn – increasing private activities solves space war and ASAT restraint.

Cobb 21 [Wendy N. Whitman Cobb, Associate Professor of Strategy and Security Studies at the School of Advanced Air and Space Studies, “Privatizing Peace: How Commerce Can Reduce Conflict in Space,” 2021, Routledge, pp. 68-69, EA]

Finally, given the involvement of an ever-larger number of private actors in space, states also need to consider the lost opportunity costs if private actors choose to forego research, development, and deployment of new technologies because the danger in space is too high. As space becomes more commercialized, these private actors can exert pressure on states to behave peacefully in order to promote further economic development. Gartzke and Quan Li argue that this can happen through the movement of capital from conflict-prone states or areas to non-conflictual states.50 This is not necessarily applicable to space because there is no area in space which is formally protected, but commercial space actors may choose not to engage in new economic investment which can in turn affect a state’s economic performance. To date, the size of the space sector is comparatively small, so, arguably, the potential economic loss would not be that great. Where the harm comes from is state reliance on private actors for military and national security space services. As states contract out space services to a greater extent, private actors exert an even greater influence over the state by having a capability they do not.

Why might private companies want a more conflict-free space? If there is weaponized conflict in space, they could potentially benefit through new launches to send up replacement satellites; this is similar to an argument that war can actually be beneficial to an economy because companies are needed to create materiel and weapons.51 But, in a debris filled environment, sending replacements is more difficult and dangerous. Some private companies want to engage in human spaceflight; a conflictual or more dangerous orbital environment would likely prevent those activities or increase their costs to such an extent that it becomes economically infeasible. James Clay Moltz argues specifically that “the growing presence of space tourists in low-Earth orbit would greatly increase the incentives for restraint in any future [ASAT] test programs.”52 Those foregone development costs and commercial activities can have a similar cost to states simply by discouraging private actors from participating in the market.

#### Space war is impossible – limited access, attribution, and interdependence.

James Pavur 19, Professor of Computer Science Department of Computer Science at Oxford University and Ivan Martinovic, DPhil Researcher Cybersecurity Centre for Doctoral Training at Oxford University, “The Cyber-ASAT: On the Impact of Cyber Weapons in Outer Space”, 2019 11th International Conference on Cyber Conflict: Silent Battle T. Minárik, S. Alatalu, S. Biondi, M. Signoretti, I. Tolga, G. Visky (Eds.), <https://ccdcoe.org/uploads/2019/06/Art_12_The-Cyber-ASAT.pdf>

A. Limited Accessibility Space is difficult. Over 60 years have passed since the first Sputnik launch and only nine countries (ten including the EU) have orbital launch capabilities. Moreover, a launch programme alone does not guarantee the resources and precision required to operate a meaningful ASAT capability. Given this, one possible reason why space wars have not broken out is simply because only the US has ever had the ability to fight one [21, p. 402], [22, pp. 419–420]. Although launch technology may become cheaper and easier, it is unclear to what extent these advances will be distributed among presently non-spacefaring nations. Limited access to orbit necessarily reduces the scenarios which could plausibly escalate to ASAT usage. Only major conflicts between the handful of states with ‘space club’ membership could be considered possible flashpoints. Even then, the fragility of an attacker’s own space assets creates de-escalatory pressures due to the deterrent effect of retaliation. Since the earliest days of the space race, dominant powers have recognized this dynamic and demonstrated an inclination towards de-escalatory space strategies [23]. B. Attributable Norms There also exists a long-standing normative framework favouring the peaceful use of space. The effectiveness of this regime, centred around the Outer Space Treaty (OST), is highly contentious and many have pointed out its serious legal and political shortcomings [24]–[26]. Nevertheless, this status quo framework has somehow supported over six decades of relative peace in orbit. Over these six decades, norms have become deeply ingrained into the way states describe and perceive space weaponization. This de facto codification was dramatically demonstrated in 2005 when the US found itself on the short end of a 160-1 UN vote after opposing a non-binding resolution on space weaponization. Although states have occasionally pushed the boundaries of these norms, this has typically occurred through incremental legal re-interpretation rather than outright opposition [27]. Even the most notable incidents, such as the 2007-2008 US and Chinese ASAT demonstrations, were couched in rhetoric from both the norm violators and defenders, depicting space as a peaceful global commons [27, p. 56]. Altogether, this suggests that states perceive real costs to breaking this normative tradition and may even moderate their behaviours accordingly. One further factor supporting this norms regime is the high degree of attributability surrounding ASAT weapons. For kinetic ASAT technology, plausible deniability and stealth are essentially impossible. The literally explosive act of launching a rocket cannot evade detection and, if used offensively, retaliation. This imposes high diplomatic costs on ASAT usage and testing, particularly during peacetime. C. Environmental Interdependence A third stabilizing force relates to the orbital debris consequences of ASATs. China’s 2007 ASAT demonstration was the largest debris-generating event in history, as the targeted satellite dissipated into thousands of dangerous debris particles [28, p. 4]. Since debris particles are indiscriminate and unpredictable, they often threaten the attacker’s own space assets [22, p. 420]. This is compounded by Kessler syndrome, a phenomenon whereby orbital debris ‘breeds’ as large pieces of debris collide and disintegrate. As space debris remains in orbit for hundreds of years, the cascade effect of an ASAT attack can constrain the attacker’s long-term use of space [29, pp. 295– 296]. Any state with kinetic ASAT capabilities will likely also operate satellites of its own, and they are necessarily exposed to this collateral damage threat. Space debris thus acts as a strong strategic deterrent to ASAT usage.

#### No debris cascades, but even a worst case is confined to low LEO with no impact

Fange 17 [Daniel Von Fange, Web Application Engineer, Founder and Owner of LeanCoder, Full Stack, Polyglot Web Developer, “Kessler Syndrome is Over Hyped”, 05/21/17, *Braino*, http://braino.org/essays/kessler\_syndrome\_is\_over\_hyped/]

Kessler Syndrome is overhyped. A chorus of online commenters great any news of upcoming low earth orbit satellites with worry that humanity will to lose access to space. I now think they are wrong.

What is Kessler Syndrome?

Here’s the popular view on Kessler Syndrome. Every once in a while, a piece of junk in space hits a satellite. This single impact destroys the satellite, and breaks off several thousand additional pieces. These new pieces now fly around space looking for other satellites to hit, and so exponentially multiply themselves over time, like a nuclear reaction, until a sphere of man-made debris surrounds the earth, and humanity no longer has access to space nor the benefits of satellites.

It is a dark picture.

Is Kessler Syndrome likely to happen?

I had to stop everything and spend an afternoon doing back-of-the-napkin math to know how big the threat is. To estimate, we need to know where the stuff in space is, how much mass is there, and how long it would take to deorbit.

The orbital area around earth can be broken down into four regions.

Low LEO - Up to about 400km. Things that orbit here burn up in the earth’s atmosphere quickly - between a few months to two years. The space station operates at the high end of this range. It loses about a kilometer of altitude a month and if not pushed higher every few months, would soon burn up. For all practical purposes, Low LEO doesn’t matter for Kessler Syndrome. If Low LEO was ever full of space junk, we’d just wait a year and a half, and the problem would be over.

High LEO - 400km to 2000km. This where most heavy satellites and most space junk orbits. The air is thin enough here that satellites only go down slowly, and they have a much farther distance to fall. It can take 50 years for stuff here to get down. This is where Kessler Syndrome could be an issue.

Mid Orbit - GPS satellites and other navigation satellites travel here in lonely, long lives. The volume of space is so huge, and the number of satellites so few, that we don’t need to worry about Kessler here.

GEO - If you put a satellite far enough out from earth, the speed that the satellite travels around the earth will match the speed of the surface of the earth rotating under it. From the ground, the satellite will appear to hang motionless. Usually the geostationary orbit is used by big weather satellites and big TV broadcasting satellites. (This apparent motionlessness is why satellite TV dishes can be mounted pointing in a fixed direction. You can find approximate south just by looking around at the dishes in your northern hemisphere neighborhood.) For Kessler purposes, GEO orbit is roughly a ring 384,400 km around. However, all the satellites here are moving the same direction at the same speed - debris doesn’t get free velocity from the speed of the satellites. Also, it’s quite expensive to get a satellite here, and so there aren’t many, only about one satellite per 1000km of the ring. Kessler is not a problem here.

How bad could Kessler Syndrome in High LEO be?

Let’s imagine a worst case scenario.

An evil alien intelligence chops up everything in High LEO, turning it into 1cm cubes of death orbiting at 1000km, spread as evenly across the surface of this sphere as orbital mechanics would allow. Is humanity cut off from space?

I’m guessing the world has launched about 10,000 tons of satellites total. For guessing purposes, I’ll assume 2,500 tons of satellites and junk currently in High LEO. If satellites are made of aluminum, with a density of 2.70 g/cm3, then that’s 839,985,870 1cm cubes. A sphere for an orbit of 1,000km has a surface area of 682,752,000 square KM. So there would be one cube of junk per .81 square KM. If a rocket traveled through that, its odds of hitting that cube are tiny - less than 1 in 10,000.

So even in the worst case, we don’t lose access to space.

Now though you can travel through the debris, you couldn’t keep a satellite alive for long in this orbit of death. Kessler Syndrome at its worst just prevents us from putting satellites in certain orbits.

In real life, there’s a lot of factors that make Kessler syndrome even less of a problem than our worst case though experiment.

* Debris would be spread over a volume of space, not a single orbital surface, making collisions orders of magnitudes less likely.
* Most impact debris will have a slower orbital velocity than either of its original pieces - this makes it deorbit much sooner.
* Any collision will create large and small objects. Small objects are much more affected by atmospheric drag and deorbit faster, even in a few months from high LEO. Larger objects can be tracked by earth based radar and avoided.
* The planned big new constellations are not in High LEO, but in Low LEO for faster communications with the earth. They aren’t an issue for Kessler.
* Most importantly, all new satellite launches since the 1990’s are required to include a plan to get rid of the satellite at the end of its useful life (usually by deorbiting)

So the realistic worst case is that insurance premiums on satellites go up a bit. Given the current trend toward much smaller, cheaper micro satellites, this wouldn’t even have a huge effect.

I’m removing Kessler Syndrome from my list of things to worry about.

#### Takes centuries and mitigation checks.

Hugh Lewis 15. Senior Lecturer in Aerospace Engineering at the University of Southampton, “Space debris, Kessler Syndrome, and the unreasonable expectation of certainty.” Room, <https://room.eu.com/article/Space_debris_Kessler_Syndrome_and_the_unreasonable_expectation_of_certainty>

There is now widespread awareness of the space debris problem amongst policymakers, scientists, engineers and the public. Thanks to pivotal work by J.C. Liou and Nicholas Johnson in 2006 we now understand that the continued growth of the debris population is likely in the future even if all launch activity is halted. The reason for this sustained growth, and for the concern of many satellite operators who are forced to act to protect their assets, are collisions that are expected to occur between objects – satellites and rocket stages – already in orbit. In spite of several commentators warning that these collisions are just the start of a collision cascade that will render access to low Earth orbit all but impossible – a process commonly referred to as the ‘Kessler Syndrome’ after the debris scientist Donald Kessler – the reality is not likely to be on the scale of these predictions or the events depicted in the film Gravity. Indeed, results presented by the Inter-Agency Space Debris Coordination Committee (IADC) at the Sixth European Conference on Space Debris show an expected increase in the debris population of only 30% after 200 years with continued launch activity. Collisions are still predicted to occur, but this is far from the catastrophic scenario feared by some. Constraining the population increase to a modest level can be achieved, the IADC suggested, through widespread and good compliance with existing space debris mitigation guidelines, especially those relating to passivation (whereby all sources of stored energy on a satellite are depleted at the end of its mission) and post-mission disposal, such as de-orbiting the satellite or re-orbiting it to a graveyard orbit. Nevertheless, the anticipated growth of the debris population in spite of these robust efforts merits the investigation of additional measures to address the debris threat, according to the IADC.

#### Modeling proves.

Drmola 18 [Jakub Drmola, Division of Security and Strategic Studies, Department of Political Science at the Faculty of Social Sciences of Masaryk University. Tomas Hubik, Department of Theoretical Computer Science and Mathematical Logic, Faculty of Mathematics and Physics, Charles University. Kessler Syndrome: System Dynamics Model. Space Policy Volumes 44–45, August 2018, Pages 29-39. https://www.sciencedirect.com/science/article/pii/S0265964617300966?via%3Dihub]

The probabilities and rates of collisions of objects from different groups were calculated using a coefficient converting the rate of collisions between objects from one group to the rate of collisions between objects from another group. The initial base rate was estimated using iterative simulations and comparison of the resulting runs with real data and outputs from other models. Detailed model built by a group of researchers from the Lawrence Livermore National Laboratory was used as a base for the calibration [see 9]. As the major factor influencing collision probability is size, the probability increases with square of the diameter representing bigger area for possible impact. Speed would be another factor influencing the probability of impacts, but the speed depends on the distance from the Earth and is not influenced by debris size. It means that it will not vary between different debris groups and thus will not influence the collision probability conversion parameters in our model.

One the most important limitations and simplifications of the model is the uncertainty of size, structure, and composition of the satellites—i.e. what debris the satellite will disintegrate into in case of a collision. Perhaps even more crucially, the rate of orbital decay changes significantly with the altitude and eccentricity of the trajectory. The lower the orbital altitude is or the more eccentric it is, the more drag the object experiences as it passes through the last vestiges of our atmosphere. Therefore, objects in the lower or more eccentric orbit will decay significantly faster. Thus, the actual lifetime of a piece of debris can easily vary from days to centuries. It also needs to be noted that while it may take many decades for a satellite to decay (especially from the popular orbits between 500 km and 800 km), we cannot assume the same about debris. That is because while satellite orbits typically have very low eccentricity, collisions result in fragments with velocities and trajectories that vary and differ from the original intact satellite (i.e. are more eccentric and decay faster). This makes estimating rate of orbital decay of debris quite difficult, especially when combined with the ongoing laudable efforts by Inter-Agency Space Debris Coordination Committee (IADC) to shorten the lifetime of satellites after they cease planned operations [14], [15].

Therefore, both the orbital and structural parameters used here are (and must be) overall averages designed to represent a “general LEO satellite” and are based on previous fragmentations, of which there are but few. Furthermore, this is getting increasingly more difficult as satellites are getting progressively more diverse, especially with the ongoing boom of the miniaturized CubeSats [16]. This leads to a relatively wide and heterogeneous population of real satellites being represented by a single, homogenized stock of simulated satellites in the model. It is also uncertain and difficult to predict how exactly is this going to evolve in the far future, what proportion of launched satellites will be of which size, and into which orbit they will be placed. Lacking precise information, we simply extrapolate current and expected trends.

5. Scenarios and simulation results

5.1. Business as usual and beyond

The baseline scenario represents a continuation of the current trends, which are simply extended into the future. An average 1% growth rate of yearly launches of new satellites (starting at 89) is assumed, together with constant success rate in satellites’ ability to actively avoid collisions with debris and other satellites, constant lifetime, and failure rate. This basic model lacks any sudden events or major policy changes that would markedly influence the debris propagation. However, it serves both as a foundation for all the following scenarios and as a basis of comparison to see what the impact would be.

Given high uncertainty regarding future state of the satellite industry (how many satellites will be launched per year, of what type and size, etc.), we elected to limit our simulations to 50 years. The model can certainly continue beyond this point, but the associated unknowns make the simulations progressively less useful.

Running this model for its full 50 years (2016–2066) yields the expected result of perpetually growing amount of debris in the LEO. One can observe nearly 2-fold increase in the large debris (over 10 cm) and 3-fold increase in small debris (less than 1 cm) quantities (Fig. 5). The oscillations visible in the graph are caused by the aforementioned solar cycles which influence the rate of reentry for all simulated populations except the still active (i.e. powered) satellites. Also please note that throughout the article, the graphs use quite different scales for debris populations because of the considerable variations between scenarios. Using any single scale for all graphs would render some of them unintelligible.

We can see that this increase in numbers still does not result in realization of the Kessler syndrome as most of the satellites being launched remain intact for their full expected service life. However, it comes with a considerable increase in risk to satellites, which is manifested by their higher yearly losses, making satellites operations riskier and more expensive for governments and private companies alike. This increased amount of debris in LEO combined with the larger number of active satellites makes it approximately twice as likely that an active satellite will suffer a disabling hit or a total disintegration during its lifetime. It should be noted that this risk might possibly be offset by future improvements in satellite reliability, debris tracking, and navigation [17].

#### No ozone impact

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

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

#### All their evidence is in the context of biodiversity loss and “mass extinction” – not human extinction.