### 1

#### CP: The appropriation of outer space by private companies is unjust except the Copernicus Sentinel-1 and -2 Satellites

#### That competes –

#### The resolution/plan is entirety of appropriation, but the PIC retains a critically important satellite duo

#### The Sentinels appropriate low earth orbit

* LEO is 2k km or less

EO 21

EO directory (essentially an encyclopedia of all recent satellite launches), Last Updated Oct. 4 2021, "Copernicus: Sentinel-1," No Publication, https://directory.eoportal.org/web/eoportal/satellite-missions/c-missions/copernicus-sentinel-1, // HW AW

As part of the Copernicus space component, the Sentinel-1 (S1) mission is implemented through a constellation of two satellites (A and B units) each carrying an imaging C-band SAR instrument (5.405 GHz) providing data continuity of ERS and Envisat SAR types of mission. Each Sentinel-1 satellite is designed for an operations lifetime of 7 years with consumables for 12 years. The S-1 satellites will fly in a near polar, sun-synchronized (dawn-dusk) orbit at 693 km altitude. [14)](https://directory.eoportal.org/web/eoportal/satellite-missions/c-missions/copernicus-sentinel-1" \l "foot14%29)

#### They save mangroves, which reduces tsunami impact by 90%

ESA 7-26-21

European Space Agency (euro intergovernmental org that documents space advancement 7-26-2021, "How satellites save mangroves from space," European Space Agency, https://www.esa.int/Enabling\_Support/Preparing\_for\_the\_Future/Space\_for\_Earth/How\_satellites\_save\_mangroves\_from\_space, // HW AW

After the 2004 Indian Ocean tsunami, Wetlands International saw that many lives had been spared by something surprising – mangroves. In response the non-profit organisation scaled up its work on protecting and restoring these complex ecosystems. One important tool in their arsenal is images from the Copernicus Sentinel-1 and -2 satellites. **Mangroves make up only a small proportion of the world's forest but are vital for humans and nature**. They are home to fish, shellfish, birds and mammals. They store more carbon per hectare than rainforests. And they protect coastal communities from extreme weather. As [Wetlands International](https://www.wetlands.org/) discovered, they can **reduce the destructive force of a tsunami by up to 90%.** [Lammert](https://www.wetlands.org/profile/lammert-hilarides/) is an information manager at Wetlands International. He explains: "After the [2004 tsunami](https://en.wikipedia.org/wiki/2004_Indian_Ocean_earthquake_and_tsunami) we saw that areas with intact mangroves suffered far fewer deaths and less damage than those with lost or damaged mangroves." [The Irrawaddy Delta in Myanmar, imaged by the Copernicus Sentinel-2A satellite. Green areas show dense mangrove forest](https://www.esa.int/ESA_Multimedia/Images/2017/07/Irrawaddy_Delta_Myanmar) Between 1996 and 2016, around [6.6%](https://oceanwealth.org/wp-content/uploads/2019/02/MANGROVE-TNC-REPORT-FINAL.31.10.LOWSINGLES.pdf) of mangroves were lost worldwide. This was down from 1% per year in the 1980s. "Historically, the biggest risk that mangroves face is from conversion to agriculture on the land side, and to aquaculture on the sea side," says Lammert. "But there is also growing pressure from climate change, with rising sea levels starting to overwhelm mangroves and changing rainfall patterns causing some to die off because of a lack of fresh water." The good news is that **most can be restored**. An online platform called [Global Mangrove Watch](https://www.globalmangrovewatch.org/) is providing **remote sensing data and tools for coastal and park managers, conservationists, policymakers and practitioners to respond by pinpointing the causes of local mangrove loss and tracking restoration progress**. [Screenshot from Global Mangrove Watch, showing the location of mangroves](https://www.esa.int/ESA_Multimedia/Images/2021/07/Global_Mangrove_Watch) Together with [Aberystwyth University](https://www.aber.ac.uk/en/), [soloEO](https://www.soloeo.com/) and [The Nature Conservancy](https://www.nature.org/en-us/), Wetlands International is a key partner in Global Mangrove Watch, so Lammert explains how the platform works: "We use satellite data to produce a map of all the mangroves around the world once a year. It currently goes to 2016 but later this year we will release maps up to 2020." But to detect destruction and stop it in time, park managers, conservationists and policymakers need information more immediately. "**We also use data from the Sentinel-1 and -2 and** [**Landsat 8**](https://www.usgs.gov/core-science-systems/nli/landsat/landsat-8?qt-science_support_page_related_con=0) **satellites to provide what we call 'change alerts' for Africa. The Sentinels reimage the same location every few days, so once a month we compare their new images with a baseline map. We send out alerts if we see a difference in mangrove cover**." [Change alerts in Guinea-Bissau](https://www.esa.int/ESA_Multimedia/Images/2021/07/Global_Mangrove_Watch2) The current baseline map was built using 2010 data from the US Landsat and Japanese [ALOS](https://global.jaxa.jp/projects/sat/alos/) satellites, but the team is currently updating it using 2021 data from the Copernicus Sentinels. This higher resolution data will give the new map a resolution of just 10 metres, compared to the current 25 metres resolution. Change alerts have already been used to catalyse action, including in Guinea-Bissau. In March 2019 a Sentinel-2 image showed that an area of mangrove in the country had been significantly destroyed. A closer look revealed that a new dam had been built and was blocking the tide from coming in and out. "We sent people on the ground to the site. They saw that the government had built the dam to turn the mangrove into rice fields. There was nothing that could be done to prevent the transformation, but often in these cases the rice fields are tended for a few years, then the mangroves grow back." [Detected changes in the mangrove in Guinea-Bissau (inset: Global Mangrove Watch) overlaid on aerial photograph (Google Maps, 2019).](https://www.esa.int/ESA_Multimedia/Images/2021/07/Mangrove_destruction_alerts_in_Guinea-Bissau) [Copernicus Sentinel-2 images showing the change in a mangrove in Guinea-Bissau between 21 March 2018 and 2 March 2021. On 21 March 2019, a dam is visible. Healthy mangrove is shown in orange. The mangrove area is getting steadily greener between 2019 and 2021, showing that mangroves are dying off.](https://www.esa.int/ESA_Multimedia/Images/2021/07/Mangrove_destruction_in_Guinea-Bissau_between_March_2018_and_March_2021) "Our change alerts currently cover Africa, but we will soon be providing them for five of the most mangrove-rich countries, including Mexico and Indonesia. We hope that the alerts will be available for the whole world in the next couple of years." "**I want to emphasise how happy we are with the Sentinel images**," concludes Lammert. "**They are free, high resolution, and available almost immediately after they are taken. This means that we can act quickly to protect and recover mangroves worldwide."**

#### Climate change induced tsunamis outweigh – coastal agriculture and populations are disrupted, nuclear power plants melt down, mass migration, infrastructure is destroyed

VT 18

Virginia Tech article summarizing tsunami simulations done by Robert Weiss (director of the National Science Foundation-funded Disaster Resilience and Risk Management graduate education program), 8-15-2018, "Climate change sea level rises could increase risk for more devastating tsunamis worldwide: Even minor sea-level rise, by as much as a foot, poses greater risks," ScienceDaily, https://www.sciencedaily.com/releases/2018/08/180815141444.htm, // HW AW

As sea levels rise due to climate change, **so do the global hazards and potential devastating damages from tsunamis**, according to a new study by a partnership that included Virginia Tech. Even minor sea-level rise, by as much as a foot, poses greater risks of tsunamis for coastal communities worldwide. The threat of rising sea levels to coastal cities and communities throughout the world is well known, but new findings show the likely increase of flooding farther inland from tsunamis following earthquakes. Think of the tsunami that devasted a portion of northern Japan after the 2011 Tohoku-Oki earthquake, **causing a nuclear plant to melt down and spread radioactive contamination.** These findings are at the center of a new Science Advances study, headed by a multi-university team of scientists from the Earth Observatory of Singapore, the Asian School of the Environment at Nanyang Technological University, and National Taiwan University, with critical support from Virginia Tech's Robert Weiss, an associate professor in the Department of Geosciences, part of the College of Science. "Our research shows that sea-level rise can significantly increase the tsunami hazard, which means that smaller tsunamis in the future can have the same adverse impacts as big tsunamis would today," Weiss said, adding that smaller tsunamis generated by earthquakes with smaller magnitudes occur frequently and regularly around the world. For the study, Weiss was critical in helping create computational models and data analytics frameworks. At Virginia Tech, Weiss serves as director of the National Science Foundation-funded Disaster Resilience and Risk Management graduate education program and is co-lead of Coastal@VT, comprised of 45 Virginia Tech faculty from 13 departments focusing on contemporary and emerging coastal zone issues, such as disaster resilience, migration, sensitive ecosystems, hazard assessment, and natural infrastructure. For the study, Weiss and his partners, including Lin Lin Li, a senior research fellow, and Adam Switzer, an associate professor, at the Earth Observatory of Singapore, created computer-simulated tsunamis at current sea level and with sea-level increases of 1.5 feet and 3 feet in the Chinese territory of Macau. Macau is a densely populated coastal region located in South China that is generally safe from current tsunami risks. At current sea level, an earthquake would need to tip past a magnitude of 8.8 to cause widespread tsunami inundation in Macau. But with the simulated sea-level rises, the results surprised the team. The sea-level rise dramatically increased the frequency of tsunami-induced flooding by 1.2 to 2.4 times for the 1.5-foot increase and from 1.5 to 4.7 times for the 3-foot increase. "We found that the increased inundation frequency was contributed by earthquakes of smaller magnitudes, which posed no threat at current sea level, but could cause significant inundation at higher sea-level conditions," Li said. In the simulated study of Macau -- population 613,000 -- Switzer said, "We produced a series of tsunami inundation maps for Macau using more than 5,000 tsunami simulations generated from synthetic earthquakes prepared for the Manila Trench." It is estimated that sea levels in the Macau region will increase by 1.5 feet by 2060 and 3 feet by 2100, according to the team of U.S.-Chinese scientists. The hazard of large tsunamis in the South China Sea region primarily comes from the Manila Trench, a megathrust system that stretches from offshore Luzon in the Philippines to southern Taiwan. The Manila Trench megathrust has not experienced an earthquake larger than a magnitude 7.8 since the 1560s. Yet, study co-author Wang Yu, from the National Taiwan University, cautioned that the region shares many of the characteristics of the source areas that resulted in the 2004 Sumatra-Andaman earthquake, as well as the 2011 earthquake in northern Japan, both causing massive loss of life. These increased dangers from tsunamis build on already known difficulties facing coastal communities worldwide: The gradual loss of land directly near coasts and increased chances of flooding even during high tides, as sea levels increase as the Earth warms. "The South China Sea is an excellent starting point for such a study because it is an ocean with rapid sea-level rise and also the location of many mega cities with significant worldwide consequences if impacted. The study is the first if its kind on the level of detail, and many will follow our example," Weiss said. Policymakers, town planners, emergency services, and insurance firms must work together to create or insure safer coastlines, Weiss added. "Sea-level rise needs to be taken into account for planning purposes, for example for reclamation efforts but also for designing protective measures, such as seawalls or green infrastructure." He added, "What we assumed to be the absolute worst case a few years ago now appears to be modest for what is predicted in some locations. We need to study local sea-level change more comprehensively in order to create better predictive models that help to **make investments in infrastructure that are or near sustainable."**

### 2

**Text: The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)’s Legal Subcommittee ought to designate outer space as a global commons.**

**Normal means for treaties involves solely the signatory countries**

**Berkeley Law Library 16**

Berkeley Law (It’s the handbook from the Berkeley law library, just a basic definition), 2016-2-23 (date from source code), "Treaties and International Agreements," Berkeley Law Library, https://www.law.berkeley.edu/library/guide.php?id=65, // HW AW

Treaties can be referred to by a number of different names: international conventions, international agreements, covenants, final acts, charters, protocols, pacts, accords, and constitutions for international organizations. Usually these different names have no legal significance in international law. **Treaties may be bilateral (two parties) or multilateral (between several parties) and a treaty is usually only binding on the parties to the agreement.** An agreement "enters into force" when the terms for entry into force as specified in the agreement are met. Bilateral treaties usually enter into force when both parties agree to be bound as of a certain date.

**The CP competes off of actor spec – they had complete control over how and who implements the aff, especially in this topic since the actor was not specified in the resolution. The actor is a key, debatable element and a change poses an opportunity cost, which is sufficient for competition.**

**COPUOS has jurisdiction and has passed treaties on similar topics in the past**

**UNOOSA ND**

UNOOSA (united nations outer space committee), 2021 (no date but written about the 2021 conference), "COPUOS 2021 Session," UNOOSA, <https://www.unoosa.org/oosa/en/ourwork/copuos/index.html> // HW AW

The Committee on the Peaceful Uses of Outer Space (COPUOS) was set up by the General Assembly in 1959 to govern the exploration and use of space for the benefit of all humanity: for peace, security and development. The Committee was tasked with reviewing international cooperation in peaceful uses of outer space, studying space-related activities that could be undertaken by the United Nations, encouraging space research programmes, and **studying legal problems arising from the exploration of outer space**. The Committee was **instrumental in the creation of the five treaties and five principles of outer space**. International cooperation in space exploration and the use of space technology applications to meet global development goals are discussed in the Committee every year. Owing to rapid advances in space technology, the space agenda is constantly evolving. The Committee therefore provides a unique platform at the global level to monitor and discuss these developments. The Committee has two subsidiary bodies: the [Scientific and Technical Subcommittee](https://www.unoosa.org/oosa/en/ourwork/copuos/stsc/2020/index.html), and the [Legal Subcommittee](https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2019/index.html), both established in 1961. The Committee reports to the [Fourth Committee of the General Assembly](http://www.un.org/en/ga/fourth/), which adopts an annual resolution on international cooperation in the peaceful uses of outer space.

**COPUOS is losing legitimacy due to an inability to reach consensus and thereby pass policies – the plan restores faith, discourages weak agreements, solves space debris, sustainability, and security issues**

**Masson-Zwaan 19**

Tanja Masson-Zwaan (deputy director of institute of air and space at Leiden University), 2019, "SYNOPSIS ON THE NEW SPACE RACE: NEW STATES IN SPACE " Cambridge, https://www.cambridge.org/core/services/aop-cambridge-core/content/view/E68383DE71B60A711EE1E4578CA303A8/S2398772319000138a.pdf/new\_states\_in\_space.pdf, // HW AW

The “old” space race started in 1957 and involved mainly the United States and the Soviet Union. These states led the development of the initial international agreements adopted in the framework of the UN Committee on the Peaceful Uses of Outer Space (COPUOS).1 Within less than two decades, between 1967 and 1984, five international treaties were adopted and entered into force.2 At the time, COPUOS had less than twenty-five member states and agreement was reached relatively easily. Gradually, the group of space actors grew, but space activity remained state-centered and involved a relatively small number of states, while private-entity involvement was mostly limited to the telecommunication sector in the United States. Today, the landscape is entirely different. Not only are more and more states interested and involved in exploring and using outer space, but private entities also have entered the scene, and the trend of privatization and commercialization of space activities is expected to gain more speed in years to come. As the number of states active—or wishing to become active—in outer space has grown, so has the membership of COPUOS, which today counts nearly ninety states.3 It has thus **become more difficult to reach consensus, which has been the working method of COPUOS from the start**. As a consequence of the growing number and diversity of stakeholders, in recent decades the **agreements among states about the use and exploration of outer space have taken the form of principles and other UN resolutions, rather than legally binding treaties**. At the same time, a growing number of new topics require states’ attention. With constant advances in technology, new capacities and activities emerge at high speed, such as ever-smaller satellites, large constellations of hundreds or even thousands of satellites, the prospect of suborbital flights, reusable launch vehicles, on-orbit servicing, and the use of resources from asteroids or the Moon. These developments were not foreseen in the early days of space exploration. Although the UN space treaties and resolutions provide the basic legal framework, some form of further elaboration is now needed to provide clear and predictable standards to govern these new activities. Issues such as the continuing congestion of outer space, the problems related to the mitigation and remediation of space debris, the long-term sustainability of space activities, space traffic management, space situational awareness, and the security of critical space infrastructure will also increasingly require the attention of the international community of states. In this changed landscape with new states, private entities, new activities, and new concerns, it is useful to look at how emerging space nations view the rules that were laid down in the past, the issues that will require regulation in the future, and whether there are any special concerns that influence their positions.4 The main principles of international space law are embodied in the Outer Space Treaty of 1967 (OST). The treaty has been widely adopted and states have consistently acted in accordance with its principles.5 In addition, states have not publicly contested those principles, proposed amendments, or withdrawn from the treaty. Thus, at least parts of the treaty could be considered to have reached the status of customary international law, meaning that they are binding on all states, including nonparties. The following sections highlight principles that are not likely to be contentious for new space states and then identify current principles and future issues that may raise more concerns.

**Revitalizing COPUOS solves great power space conflict – it is the single organization that has enough member states, legitimacy, and empirical success to ensure peace – it stopped the first space race, it can do it again**

**McMillan 21**

Anne Mcmillan (journalist trained in law, chai tea enthusiast), 7-14-2021, "The final frontier – 21st century space race," International Bar Association, <https://www.ibanet.org/the-final-frontier> , // HW AW

As far as international oversight is concerned, the UN Committee on the Peaceful Uses of Outer Space (COPUOS) is the main forum governing the exploration and use of space. But it has failed to achieve an agreement on the interpretation of the broad concepts outlined in the OST, and legal developments since 1979 have been in the form of soft law guidelines and principles. Perhaps multinational initiatives led by individual states, such as the recent US-sponsored Artemis Accords, signal an alternative route. These envisage a series of bilateral agreements between the US and individual countries in the context of planned future exploration of the Moon, Mars, comets and asteroids. Nacimiento thinks such initiatives could help to develop space law. ‘There is some indication that international space law may develop in a different form, meaning not necessarily within the United Nations Committee on the Peaceful Uses of Outer Space and via multilateral international treaties. The Artemis Accords signed in October 2020 are one very recent example of how space law could develop in the future.’ However, not all states support the US-led initiative and so far the Artemis accords have only been signed by eight countries. Predictably China and Russia are prominent critics, objecting in particular to a suggestion in Artemis to create ‘safety zones’ around national lunar exploration sites, arguing that this amounts to a creeping claim of sovereignty. Nacimiento concedes that the provision for such zones under Artemis ‘could be in conflict with existing international law prohibiting any form of national appropriation of celestial bodies. It remains to be seen how these Accords work in practice and if they develop into generally recognized principles of cooperation.’ Although much of Artemis reflects existing international law, its future is likely to depend on as much as law itself. The mere fact that the process is led by the US seems to have stoked the fires of competing states, with the head of Russia’s space agency dubbing it ‘too US-centric’. Consequently, China and Russia signed an agreement this year to set up a rival system for exploration of the Moon, planning to establish a joint ‘International Lunar Research Station’. This, like the US-led effort, seeks to attract international partners. Monthly number of objects in Earth orbit by object type As China-Russia cooperation increases, Russia-US cooperation is waning. For many years the International Space Station has been a beacon for international cooperation in space, notably as a forum for detente between Russia and the US. However, it will eventually be de-orbited, possibly as soon as 2024, and with its demise will go a touchstone of cooperation between historical rivals. Clearly, events in space exploration have moved on since the 1967 OST which reduced tensions between Russia and the US. But now, with China as a significant new player, we seem to be witnessing a reignition of the space race. ‘The UN, notably its COPUOS, is still the best forum for all discussions on where the OST and the rest of the framework might need further elaboration, interpretation and implementation, comprising basically all the spacefaring nations,’ says von der Dunk. Based on experience, are international bodies helping to reduce friction in space?

### DA – Private also good

#### The US government is perfectly positioned to focus on space governance and let private entities develop tech – this avoids bilateral or unilateral missions that increase the chance for conflict and space weaponization while creating effective multilateral agreements that spill over

Rosenberg and Marber 21 (Mark Y. - CEO of Geoquant and an adjunct professor at Columbia University’s School of International and Public Affairs, Peter - teaches at Harvard University and is a senior portfolio manager at Aperture Investors, 2/22, “America Needs a Supercharged Space Program,” [accessed 9/25/21], <https://foreignpolicy.com/2021/02/22/biden-space-force-race-policy-rockets-china/>)

In 2015, the U.S. government granted U.S. citizens the right to own any materials they extract in space, blowing open the door for civilian space business. In 2018, China launched a reconnaissance rover on the moon’s far side that’s been gathering data for more than 18 months now. In late 2019, then-President Donald Trump launched the formation of the U.S. Space Force as part of the military, while early 2020 saw the National Aeronautics and Space Administration (NASA) sign a contract with Axiom Space to build the first commercial space station. And in October 2020, the United States led the signing of the Artemis Accords, a set of bilateral agreements on space with Australia, Canada, Italy, Japan, Luxembourg, Italy, the United Kingdom, and the United Arab Emirates, which deliberately skirted the United Nations and did not include space rivals such as China and Russia. (Ukraine and Brazil were later added to the accords.) Although this pact claims to affirm the Outer Space Treaty, it actually increases the potential for conflict by expanding the interpretation of commercial space law while drawing hard geopolitical borders. Without Russia and especially China on board, much of the world will see the Artemis Accords as the informal rulebook of a cliquish club rather than a true multilateral agreement. Meanwhile, a new space race is gathering stream: In addition to this year’s unmanned missions to Mars, both the United States and China are planning moon landings later this decade. The Biden administration must prioritize a more multilateral approach to space governance than what was taken under Trump. Just like on Earth, a lack of international standards in space will likely lead to chaotic, wasteful competition. A 2011 U.S. law blocking NASA from cooperating with Chinese agencies has already shut China out of the U.S.-Russian International Space Station, prompting the Chinese to start building their own while partnering with Russia on a lunar research station. Revising this law would be a good place for the Biden administration to start. Cooperating with China in space might be a sensible hedge against growing conflict on Earth. Unregulated space activity could create a myriad of problems from accidentally or intentionally blocked data transmission to orbital pollution from too many space objects. Indeed, U.S. companies are currently the worst offenders, highlighting the need for more targeted regulation. Just a few uncontrolled collisions could generate enough debris to render near-Earth space unusable. And of course, no one wants to see space weaponized with extremely expensive, escalating arms races. Given private U.S. companies’ increasingly aggressive push to expand space exploration, the U.S. government is in a position to structure a more effective extraterrestrial regulatory regime. Renewed U.S. leadership founded on rebuilt space capabilities will be key to any hope for multilateral space cooperation. A more dedicated focus on space governance and a more aggressive approach to exploration can be the underpinnings of a future “New Space Deal.” A supercharged space program can help build entire new industries, create new jobs, green the economy, turbocharge next-generation communications, and expand the frontiers of science and technology. By uniting Americans behind a common purpose, it could even help mend the country’s frayed democracy. It would also reestablish Washington’s leadership in the fight against climate change and for a stronger multilateral system. Who else but the United States could even contemplate such a bold plan?

#### Non-state actors in space are conflict dampeners – they avoid geopolitical tension and have financial incentives to keep conflict low

Frankowski 17 (Pawel, Assistant Professor at the Faculty of National Security. His current research interests include space policy, labour standards in free trade agreements, and theories of international relations, Jagiellonian University in Kakow, “OUTER SPACE AND PRIVATE COMPANIES CONSEQUENCES FOR GLOBAL SECURITY”, <https://doi.org/10.12797/Politeja.14.2017.50.06>)

In the terms of privatization and space security, space remains relatively untapped, but commercial and military benefits from space exploration/exploitation could even lead to ‘privatization of space’. Such privatization will result from growing pressure on spacefaring countries to defect from cooperation, since is less viable with good number of multiple actors who entered the space.36 However, space policy and space research are characterized by very high costs, which are rather impossible to bear by private companies, limited by economic calculation. As pointed out earlier, under-investment in technological development by private companies it is related to the fact that these actors are not focused on profits of a social nature, such as improving the quality of life of the recipient of the product.37 This makes some technology, potentially beneficial to society, not developed or introduced into use, because the profit margin is too small to make this viable for commercial players. To conclude, privatization of space security can develop in unexpected ways, but in today’s space environment private actors would rather play the role of security regulators than security providers. When investment in space technologies is less profitable than other areas of economy, private actors would focus on soft law and conflict prevention in space, and new private initiatives will appear. For example, apart from important space companies, as SpaceX or Blue Origin active in outer space, other private actors as Secure World Foundation (SWF), who focus on space sustainability, will play more important role in crafting international guidelines for space activities.38 This path the way for future solutions and projects, as cleaning the space debris, extracting resources from asteroids and planetoids, refuelling satellites, providing payload capabilities for governmental entities on market-based logic, will be based on activity non-state actors, providing soft law and regulatory solutions, where space faring states are unable to find any compromise. Therefore private companies will be in fact global (or space) regulators, as part of UNCOPUS, being involved in space activities.39 The last argument for private involvement in space security comes from an approach based on common good and resilience of space assets, emphasized by the Project Ploughshares, as an important part of space security. As of 2017 there are more than 700,000 man-made objects on the Earth’s orbit bigger than 1 cm, while 17,000 of them are bigger than 10 cm.40 Some of them are traced by SSA systems, both American and European, but these systems are public-military owned, and private operators are not granted any access to this data. Any collision of space object with space debris, even with small particles, might result in a chain reaction, called Kessler’s syndrome, and not only private but public, and military assets will be destroyed or impaired. In such conditions, a reluctant cooperation between the public and private sector, and unwillingness to share vulnerable data by public actors seem to confirm that private space activity is more than necessary. This is an apparent case when logic of mistrust between state powers must be overcome by private actors, perhaps by suggesting common preferences for debris mitigation, and space situational awareness. In the case of space debris, Space Data Association, an initiative supported by private sector, with its main aim to enhance data sharing between commercial satellite operators, could be an example of nascent public good provided by private actors for the sake of global security.

#### Space weaponization and arms racing ensure space war goes nuclear – only strong private competition can check conflict

Hitchens ’17 (Theresa Hitchens, Theresa Hitchens is Senior Research Scholar at the Center for International and Security Studies at Maryland, Prior to joining CISSM, Hitchens was the director of the United Nations Institute for Disarmament Research (UNIDIR) in Geneva from 2009 through 2014. Among her activities and accomplishments at UNIDIR, Hitchens served as a consultant to the U.N. Group of Governmental Experts on Transparency and Confidence Building Measures in Outer Space Activities, provided expert advice to the Conference on Disarmament regarding the prevention of an arms race in outer space (PAROS), and launched UNIDIR's annual conference on cyber security, From 2001 to 2008, Hitchens worked at the Center for Defense Information, where she served as Director, and headed the center’s Space Security Project, setting the strategic direction of the center and conducting research on space policy and other international security issues, “Space weapon technology and policy”, School of Public Policy University of Maryland, <https://aip.scitation.org/doi/pdf/10.1063/1.5009221?class=pdf>, November 2017)

Abstract. The military use of space, including in support of nuclear weapons infrastructure, has greatly increased over the past 30 years. In the current era, **rising geopolitical tensions between** the United States and Russia and China **have led to assumptions** in all three major space powers **that warfighting in space now is inevitable, and possible because of rapid technological advancements**. New capabilities for disrupting and destroying satellites include radio-frequency jamming, the use of lasers, maneuverable space objects and more capable direct-ascent anti-satellite weapons. **This situation, however, threatens international security and stability among nuclear powers. There is a continuing and necessary role for diplomacy, especially the establishment of normative rules of behavior, to reduce risks of misperceptions and crisis escalation, including** up to the **use of nuclear weapons**. U**.S. policy and strategy should seek a balance between traditional military approaches to protecting its space assets and diplomatic tools to create a more secure space environment.** I. INTRODUCTION Outer space is recognized by all nations as “the province of mankind” not subject to national boundaries or appropriation via both treaty – especially the 1967 Outer Space Treaty1 – and by the practice of nation states. Since the dawn of the space age, the use of satellites has become integral to the global economy, including providing communications, weather services, mapping, precision timing and navigation services for shipping, secure crossborder banking, and Internet connectivity. Every state has both an interest in making use of space, and reason to deal with its use by other states, because **the activities in space by one actor have the potential to impact all others**, for good or for bad. In addressing international and national security, and nuclear security in particular, the space environment has played a role of great importance from almost the beginning of the nuclear age. The first satellites launched by the Soviet Union and the United States were oriented toward seeking information on what was transpiring in areas controlled by the other, and to verify bilateral arms control agreements. While in short order space systems also were integrated to the offensive uses of long-range delivery systems by providing photographic information about potential targets, strategic space systems were during the Cold War widely viewed as stabilizing the Superpower nuclear competition. The use of space for military purposes has continued into the present era, with increasing capabilities to take advantage of large segments of the electromagnetic spectrum for acquiring intelligence, communicating globally, and generally supporting ways of using nuclear weapons both for deterrence, and, should deterrence fail, use of those weapons against an adversary. Most of the nuclear weapon possessing states operate satellites for these purposes. Perhaps as importantly, space systems over the last two decades have become integral to the tactical warfighting ability of many modern states – a situation that has complicated the status of space systems as strategically stabilizing. Indeed, the growing use of space by many countries to achieve victory on the battlefield has increased both the vulnerability of militaries to attacks on their space systems and has, at the same time, increased their value as potential targets in a war. Over the past 50 years, the Soviet Union, the United States, and China have carried out experiments in or aimed at the outer space environment – mostly the area close to the atmosphere in Low Earth Orbit (LEO) – that show the capability to destroy a satellite, or to disrupt its functions. The specter of space warfare for many years has, among other negative consequences, raised concerns that a state’s nuclear retaliatory capability could be compromised. This concern also applies more generally, of course, to an ability to disrupt communications functions for other military, or civilian, purposes. In the 1980s, there was a period when the United States, and perhaps others, explored whether systems based in space could be used to destroy an adversary’s intercontinental ballistic missiles, or their payloads. The so-called Star Wars program under the Reagan Administration envisioned the deployment of a system of satellites that would seek to destroy the missiles/warheads launched at the United States. One technology explored envisioned detonating a nuclear explosive to generate a beam of x-rays that would put out of commission the adversary’s warhead. Thus far, such technologies have not succeeded in playing a role in the nuclear-weapon situation globally. However, the U.S. descendant of the Star Wars program – currently limited to conventionally equipped, ground- and sea-based missile defense interceptors with limited capability against a full-blown nuclear attack – continues to stress nuclear deterrence and stability between the United States and Russia, as well as China, which maintains a much smaller nuclear arsenal than the Cold War adversaries. However, recent missile experiments by China have demonstrated the vulnerability of the geosynchronous equatorial orbit (GEO), where many hundreds of satellites are “parked” carrying out communications and other functions, including nuclear weapons support systems and spy satellites. II. INCREASED THREATS INVOLVING OUTER SPACE Since the first satellites were launched in the 1950s by the Soviet Union and then the United States, the Russian Federation, the United States, China, India, Japan, and other states have, without much coordination, launched so many satellites into space into various orbits and at various altitudes that there is currently a strong risk of both congestion and competition. There is no global regime for regulating outer space activities. The Outer Space Treaty of 1967, to which all the launching states, and most others, are party2 mandates that outer space be used solely for peaceful purposes, and prohibits the stationing of nuclear or other weapons of mass destruction in that environment. (The Treaty does not prohibit the transit of nuclear weapons, e.g. as a payload on a submarine-launched ballistic missile, through outer space; furthermore under common law practice, defensive military activities are tolerated as compliant with “peaceful purposes.”) The Outer Space Treaty, however, makes it clear that states are responsible for their own space activities, and compliance with international law. And while there are a number of other spacerelated treaties, UN principles and voluntary agreements managed by various UN and multilateral bodies, a nation’s activities in space are largely regulated by that nation alone. There is no international legal requirement for any one state to coordinate its satellite launches or maneuvers with others. Environmental Threats: Crowding and Debris Some 1,500 operational satellites are now in orbit, owned by more than 80 states or other entities. These states and entities have varying levels both of proficiency and of knowledge of the established laws and rules affecting space. In the radio frequency band of the electromagnetic spectrum, interference is rising, especially in the GEO regime. Some of this interference is deliberate, undertaken for political purposes, despite the fact that deliberate interference is one of the few legally binding restraints in the international space arena3 . The evolution in satellite technology has led to the wider use of smaller satellites, including so-called “Cubesats,” that can be deployed in constellations, especially in LEO. The number of operational satellites is expected to rise to many thousands within the decade. LEO, in particular, is becoming incredibly crowded with satellites, making tracking of on-orbit objects extremely difficult. Furthermore, many small satellites have no ability to maneuver to avoid collisions with other satellites and space debris. The half-century of using space has resulted, from the breakup of satellites and other activities, in a considerable amount of on-orbit debris – including satellites no longer in use, parts of satellites that have broken up, launcher stages, nuts and bolts, and debris from the deliberate destruction of satellites. The United States and others track some 23,000 orbiting pieces with a diameter of greater than 10 cm. This debris is especially dangerous if a satellite or transiting vehicle collides with a piece, since the closing velocity of such a collision on-orbit is very high – some 7.5 kilometers per second (faster than a bullet) in LEO. Worse yet, even very small debris, most of which cannot be detected much less tracked, can destroy an operational satellite; it is estimated that some 500,000 to one million pieces of debris smaller than 10 centimeters exist on orbit. **It is widely agreed that new international measures to better coordinate space activities are required to ensure that the space environment is sustained**. In 2007, the United Nations Committee for the Peaceful Uses of Outer Space (COPUOS) in Vienna, Austria, agreed on a set of guidelines for the mitigation of space debris, which are slowly being implemented by many space-faring states. It may be that such measures will eventually require removal of debris from orbit, as the decay of debris from space into the atmosphere where it burns up (or falls on Earth) is a very long-term prospect, taking as much as 25 years in LEO. Sadly, the lifetime of debris in GEO, like diamonds, is practically forever. COPUOS currently is working on a set of recommended best practices to ensure the “long-term sustainability of space.” COPUOS has a 2018 deadline to finish this work; however, there is already discussion of follow-on effort that may include international guidelines for debris removal. Increasing Military Tensions in Space In the geopolitical sphere, compared with the period following the breakup of the Soviet Union, the current decade is witnessing increased tensions between the United States and Russia, and between the United States and China. The geopolitical situation in space has been further eroded by the proliferation of experimentation with and/or deployment of dual-use technologies with “counterspace,” i.e. satellite attack, capabilities. As noted above, China, Russia and the United States all have tested (or in some cases deployed) such technologies in both LEO and GEO. The United States continues to have an advantage in military space capabilities, but its edge is eroding as China and Russia dedicate more resources. Most technologies involved in sustaining systems in orbit are dual-use, but certain specific activities are raising suspicions about potential intended weapons use. The capability to maneuver satellites is particularly relevant. Russia placed a satellite called Luch/Olymp in GEO that maneuvered or drifted over a considerable range, and at several points in 2015 came extremely close to commercial satellites owned by Intelsat.4 Intelsat called the move “irresponsible,” but their request for information from Russia went unanswered. The maneuvers further prompted concern at the U.S. Defense Department about the satellite’s mission, which has not been revealed by Moscow. The United States also has carried out programs in GEO that could have potential weapons capabilities. For example, the PAN, an acronym for Palladium at Night, is a classified program apparently dealing with communications platforms, and perhaps providing other capabilities.5 The Geosynchronous Space Situational Awareness Program (GSSAP) is a U.S. military satellite constellation that also maneuvers in orbit, designed, according to the Pentagon, with the objective of inspecting other satellites orbiting in GEO. Such activities are known as Rendezvous and Proximity Operations (RPO), and have a number of benign applications such as satellite refueling, inspection and repair. Russia is carrying out other such experiments in LEO, as are China, the United States, Japan and Sweden. The commercial applications of maneuvering satellites are also increasing. Among the number of more directly identifiable counterspace technologies now available, the most widespread are ground-based radio-frequency jammers, which can be used to disrupt satellite communications and operations. In addition, there are efforts to develop lasers for disrupting or degrading systems based in space. Russia, China and the United States have also carried out projects involving terrestrially based missiles carrying anti-satellite payloads. The United States as early as the 1980s launched missiles from an F-15 fighter jet with this objective. A 2007 Chinese test, involving the destruction of a non-functional Chinese weather satellite in LEO, released a considerable quantity of debris. The United States subsequently launched a missile from an Aegis cruiser that was advertised to have the objective of destroying a satellite in a decaying orbit, but this did not prevent speculation that the mission also had the objective of demonstrating a similar capability to that of China. Over decades, the U.S. missile defense program has also heavily relied on the space environment, for early warning, for communications, and as a place for engaging and destroying hostile systems. Noted above is the Reagan Administration’s “Star Wars” program, pursued with the idea of creating a “shield” against intercontinental ballistic missiles. **The harder-line rhetoric that has been employed in recent years also has had an inevitable impact of raising tensions**. The United States has pivoted from an approach of “strategic restraint” to one emphasizing “warfighting.”6 In particular, the budgets for providing resiliency in space systems and counterspace capabilities have been increasing. At the same time, Russian accusations that U.S. activities have a hostile objective, and its responses to U.S. representations, have become shriller. Russia has called the anti-ballistic missile system SM-3 2A an anti-satellite weapon, while touting its own objectives for acquiring anti-satellite capabilities. In 2013, China tested a missile, the Dong Ning-2, which appears capable of reaching satellites in GEO. Chinese military space activities lack transparency, but it seems clear that such activities include the objective of being able to exercise counterspace actions. Most troubling, there has been a lack of serious dialogue among these Big Three states. Multilateral Efforts to Reduce Risks For many years, a direct approach to concerns about the potential for weaponizing space (space has been militarized since the dawn of the space age, but so far cannot be said to have been weaponized) has been debated within the United Nations, as well as at the Conference on Disarmament in Geneva. The Russian-Chinese cosponsored initiative, on the Prevention of an Arms Race in Outer Space, has been on the agenda of the Conference on Disarmament since 1985, and under that agenda item Moscow and Beijing have proposed a treaty to ban weapons in space.7 However, the Conference has been all but immobilized by wider disagreements since that time; and the United States remains firmly opposed to the proposed treaty. There have been a number of efforts to set norms of behavior in space in order to guard against misunderstanding and conflict in space. Most recently, the 2013 UN Group of Governmental Experts (GGE) on Transparency and Confidence-Building Measures in Outer Space Activities released a set of recommended initiatives for states to implement, including improved communications about objects in orbit.8 Unfortunately, little work has been done since to implement the recommendations, either at the multilateral level or by individual states. However, the United States, Russia and China have recommended that the UN Disarmament Commission, based in New York, and the deliberative body on arms control issues, take up the question of implementation of the GGE recommendations. While the initial proposal has been received favorably, a decision regarding whether to put the issue on the Commission’s formal agenda will not be made until Fall. III. POLICY QUESTIONS FOR THE UNITED STATES In view of the increased uncertainties affecting the use of outer space, particularly in the area of international security, the United States needs to address several issues with some urgency. First, what is the appropriate mix of resiliency measures to apply in the coming years? A subsidiary question in this regard is what is an appropriate role for commercial providers? And should the U.S. military switch to constellations of small satellites for some national security missions? The budgetary implications of achieving objectives, and establishing appropriate requirements, are important components of pursuing this mix. And there is the inevitable bureaucratic overlap between the Department of Defense and the Intelligence Community. Such “turf” issues require constant attention lest they adversely impact on the fulfillment of national, vice institutional, objectives. Lengthy acquisition programs put systems at risk of becoming obsolescent earlier than they would otherwise become outdated. As part of this latter issue, the United States will need to consider what reforms are needed in the acquisition process, and related organizational arrangements. The integration of Department of Defense and Intelligence Community programs and activities is inevitably a delicate matter; it will require especial focus from the White House, in particular as resiliency is now being embedded into the requirements for acquisition of new systems. A more far reaching issue is how best to strike a balance between the defensive aspects of counterspace and the offensive aspects. And integral to addressing this balance is the impact of U.S. options to respond to hostile space activities on the stability of the strategic/nuclear relationships: U.S.-Russia, U.S.-China, and a large number of other such relationships involving the nuclear-weapon-possessing states. If “arms racing” resumes, or, in the case of India and Pakistan, continues, how will the use of space, specifically for counterspace activities, impact on these races, and vice-versa? Will there be a deterioration in nuclear deterrence? Will an offensive strategy involving the targeting of an adversary’s nuclear-related satellites emerge? These are questions that beg answers in the near-term, as budgetary and policy decisions are being made. **It is also important to consider the role of diplomacy in dealing with international security for outer space.** Diplomacy, in the form of both self-restraint and in reassurance of potential adversaries regarding intentions, has been a part of the tool kit for managing competition in space from the beginning of the space age. Can effective “rules of the road” be further developed? The limited success, but slow pace, of multilateral efforts should not be seen as failure, however. Diplomacy is a difficult business, often characterized by a “one step forward, one step back” dynamic. There is some optimism to be found in the ongoing COPUOS effort, which while a slightly sideways approach, will have positive impacts on international security if successful. While the Disarmament Commission has little power, the advent of discussions there would provide a much needed multilateral forum for addressing the security issues for space given the decades-long impasse at the Conference on Disarmament. Finally, **one should not overlook the value of bilateral diplomacy, particularly among the Big Three space powers. Further work will also be needed to regulate the proliferation of technologies in the commercial sector**. This will likely involve export control, and measures for the management of “traffic” in space (STM). However, care must be given to weigh national security concerns against the needs of commercial industry to thrive in the international marketplace. There is a tendency in the national security community to try to “close the barn door after the horses have escaped” that must not be indulged in the space domain, given the reliance of the national security sector on commercial capabilities and technological innovation. IV. THE NEED FOR A “TIME OUT” To date, no state is deploying dedicated anti-satellite weapons. Testing of capabilities does not a program make. That said, the trend lines are currently negative and require both time and analysis to mitigate. It would be irresponsible for the United States, or any other country, to leap to conclusions about the “inevitability” of all-out war in space. A balanced strategy, which combines resiliency, deterrence, and diplomacy **will be required to** protect national security and **ensure international security**. While development of some anti-satellite capabilities for potential future use may be wise, a run-away space arms race is not desirable for any party. It may be that a viable modus vivendi could be a situation of “implied deterrence:” i.e., the development of dual-use technologies with inherent weapons capabilities in a transparent manner so as to provide the knowledge to others that, if pushed, antisatellite weapons could be deployed. And despite the difficulties to date, **the prospect of the multilateral establishment of norms shows some possibility of promise.** This involves the implementation of recommendations by the Group of Governmental Experts discussed above; of the COPUOS LTS (long-term sustainability) best practices work making progress by 2018; the successful efforts to codify the legal regime that are underway (e.g., those at McGill University in Montreal), and perhaps the UN Disarmament Commission addressing TCBMs in 2018. These efforts must be given a chance to ripen, however much frustration is involved in the processes. It can perhaps be helpful to think of the world as being surrounded on all sides by a large fishbowl, of indefinite dimensions in the outward direction, with the atmosphere at the intersection between “outer” space and the land and waters below. Looked at in this way, human activities in outer space have little room to be confined to a single state: the world as a whole is impacted by those activities. Accordingly, when dealing with outer space, traditional concepts of absolute roles for state sovereignty must inevitably be modified to serve the objectives of global peace, security and stability. Whether this reality will at some point lead to an appreciation that reliance on force, nuclear weapons in particular, cannot play the role in space that it does on the Earth, remains to be seen.

### turns

**1] Scientific consensus proves warming is inevitable absent negative emissions technologies – only capitalism solves.**

**Welch 19**

(Craig Welch, environment writer at National Geographic. Prior to joining National Geographic, he was the environmental reporter for The Seattle Times, where he worked for more than 14 years. A journalist for two decades, his work has appeared in Smithsonian magazine, the Washington Post, and Newsweek. He spent a year as a fellow at the Nieman Foundation for Journalism at Harvard University, and the Society of Environmental Journalists has twice named him Outstanding Beat Reporter of the Year, mostly recently in 2010. That same year, HarperCollins published his book, "Shell Games: A True Story of Cops, Con Men, and the Smuggling of America's Strangest Wildlife," a nonfiction detective story about wildlife thieves. It won the national Rachel Carson Environment Book Award in 2011 and was a finalist for the Pacific Northwest Booksellers Association award and the Washington State Book award. Welch and photographer Steve Ringman's Pulitzer Center-supported five-part series on ocean acidification "Sea Change: The Pacific's Perilous Turn" for The Seattle Times has won numerous including the Online Communication Award from the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine, the Overseas Press Club Whitman Bassow Award, the ONA Online Journalism Award for Explanatory Reporting, and an Emmy Nomination for New Approaches to News & Documentary Programming, “To curb climate change, we have to suck carbon from the sky. But how?”, National Geographic, 17 January 2019, accessed: 12 March 2021, https://www.nationalgeographic.com/environment/article/carbon-capture-trees-atmosphere-climate-change, R.S.)

**The world must** quickly **stop burning fossil fuels. And** **that is no longer enough.**

Again and again, including in a major report published fall, the Intergovernmental Panel on Climate Change and other science bodies have reached a stark conclusion: Most paths to halting global temperature increases at 2 degrees—and every path **to** reach **1.5 degrees**—rely in some way on adopting methods of **sucking CO2 from the sky.**

It is a significant about-face. For years many scientists dismissed or downplayed the most highly engineered CO2 removal strategies. Those techniques were often lumped in with more dangerous forms of "geoengineering," such as injecting sulfates or other aerosols into the stratosphere to reflect sunlight and cool the planet. Focusing money and energy on any such technological fix seemed both risky and fraught with "moral hazard"—a distraction from the urgent need to cut emissions by slashing use of coal, oil, and gas.

But now many see "negative emissions," as CO2 removal strategies are also called, as an essential bridge to a clean-energy future.

"**CO2 removal has gone from a moral hazard to a moral imperative**," says Julio Friedmann, senior research scholar at the Center for Global Energy Policy at Columbia University.

There are several reasons for the shift. For starters, attempting to set a hard target at 1.5 or 2 degrees gives the world an emissions cap. With carbon emissions from fossil fuels estimated to have risen 2.7 percent in 2018, we're clearly not moving fast enough to reduce emissions—or even in the right direction.

"The longer we have postponed drastic reductions, the more daunting the challenge of achieving those reductions in the necessary time frame," says Erica Belmont, a University of Wyoming engineering researcher.

Even if the developed world rapidly switched to clean fuels, poorer countries would likely take longer. Emissions from some industries, such as cement and steel production, will be hard to eliminate, and alternative fuels for air travel are expected to remain expensive for quite some time.

Rapid progress

The good news is that CO2-removal technology has advanced far faster than expected in the last decade, says Stephen Pacala, a Princeton professor who oversaw a study of carbon removal strategies published this fall by the National Academies of Science.

The costs of machines that directly capture CO2 from the air **have fallen by two-thirds or more.** Meanwhile, at least **18 commercial-scale projects** around the world already capture CO2 from the smokestacks of coal or natural gas plants, storing it underground or even using it to create other products. Costs of that technology have **dropped by half in a dozen years.** While removing CO2 from smokestack gases is not the same as removing it from the ambient air—the former prevents new emissions, the latter cleans up old ones—both techniques require some means of sequestering CO2 after it’s captured. Additionally, advances in research and development from industrial carbon-capture can help **drive innovation** in efforts to pull old carbon from the atmosphere.

"Post-combustion carbon capture and direct air capture processes have significant components where know-how is transferable," says Christopher W. Jones, associate vice president for research at Georgia Institute of Technology.

Equally important, the **political will to subsidize carbon removal appears to be growing.** Even a **GOP-led Congress hostile to climate change worked** last year **with climate hawks** like Sen. Sheldon Whitehouse, D-Rhode Island, **to approve a $50-a-ton tax credit for** specific types of **CO2 removal**, including negative emissions techniques such as direct-air capture.

“We need to design and deploy technology to capture lots of carbon from our atmosphere at a pace never before seen," Sen. Whitehouse told National Geographic. "That’s why I’ve been pursuing legislation to help drive the development of that technology."

"You are a pessimist if you work on the science of climate impacts, because you see little action," Pacala says. "The people who know the most are the most freaked out. They've seen emissions go up and up andsee a train wreck coming."

But scientists studying negative emissions, Pacala continues, "have seen the most spectacular technological achievements in energy technology in the last 10 years. We've gone from having no tools to do this, to just seeing this unrelenting progress."

He and the other authors of the National Academies report concluded that a concerted multi-billion-dollar research and development push by government and the private sector might **within 10 years** produce market-ready technology that directly removes CO2 from ambient air **on a massive scale.**

But even evangelists such as Pacala and Whitehouse insist that direct air-capture technology can at most fill in the gaps in an overall effort to decarbonize the economy. It will never reach a scale that would save us from having to wean ourselves from fossil fuels—or from having to manage the land much better than we do now. First, do no harm The first step in improved land management is to halt practices that require carbon-removal in the first place, such as large-scale land clearing and burning. Halting deforestation in Indonesia and Brazil alone could reduce emissions equivalent to those produced by every car and light truck on the road in the United States. "Dealing with tropical deforestation is huge, huge, huge," says Katherine Mach, senior research scientist at the Woods Institute for the Environment at Stanford University. Retaining trees does more than just pull carbon from the atmosphere. Since the Amazon produces its own moisture, tree loss can lead to drought and fire, which could quickly destabilize and flip the forest to another type of landscape—one that would release its stored carbon. Replanting trees, on the other hand, could reduce atmospheric greenhouse gases even more. Simply restoring forests already chopped down in Brazil could draw about 1.5 billion metric tons of CO2 out of the air. While trees grow fast in the tropics, forest restoration shouldn't be limited to remote places. In fact, managing most land in the U.S. with an eye toward carbon reduction—both limiting new emissions and looking for places to pull CO2 back out of the atmosphere—could achieve the equivalent of cutting the country's emissions by 21 percent, according to a recent study in Science Advances. Managing land for carbon reduction would include restoring trees to native forests, slowing logging rotations on Southeast timberlands, and planting more trees in some 3,500 cities. But it also would mean better managing forests to reduce catastrophic wildfires, reconnecting tidal marshes cut off from the ocean, and restoring seagrasses. Cover crops would need to be added between plantings on every acre of corn, soil, wheat, rice, and cotton in the U.S. It's ambitious—and essential to at least try, says Joe Fargione, science director for The Nature Conservancy and lead author of the recent study. "The track that we're on with climate change is so dangerous that it requires an all-hands-on-deck approach," Fargione says. "This could buy us 10 years." Many—but not all—of the actions envisioned by his team would require a price on carbon to motivate landowners to change behavior. And there are potential pitfalls. Probably the most important one is that managing land for carbon reduction could conflict with managing it for food production. With global food demand set to increase substantially over the next few decades, restoring the wrong farm land back to native forest or grasslands could limit food availability and send price shocks through the system. Then there is the obvious challenge of realizing the theoretical potential of natural carbon reduction, not just in the U.S. but on a globe covered by a tremendous diversity of landscapes and governed by a mosaic of rules and owners and political situations. In Brazil, for example, the new president-elect threatens to increase deforestation, not tree-planting. The situation in the U.S. is not necessarily easier. "There are 11 million forest landowners just in the U.S," Birdsey says. "Getting 11 million families or entities to do anything—that's a big challenge. Most programs that try to get even 10 percent of potential landowners to participate fail." That's why the National Academies study is far more conservative[RK11] than the research published by Fargione’s team in Science Advances. It assumes that forests and farms worldwide could realistically pull only 2.5 gigatons of CO2 from the atmosphere a year. A massive buildout of a technique called bioenergy with carbon capture and sequestration—in which crops, wood, or waste biomass are burned for electricity or fuel, and the resulting CO2 is captured and stored—would double the amount of CO2 removed, the National Academies study says Still, that would be a real achievement. Five gigatons of CO2 amounts to about half of fossil fuel emissions in the United States, the world's second-largest polluter. Back on the farm At McCarty Family Farms the move toward a carbon-friendlier operation was a slow evolution that highlights landowners' competing motivations. The family relocated from eastern Pennsylvania to the Midwest almost 20 years ago. As its farms grew to 8,500 cows, the family began moving toward sustainability, but not for any single reason. New research confirms that cover crops soften soils and make them richer, increasing yields. That also fights wind erosion, and much of the McCartys' land abuts highways, where dust blowing from fields can cause accidents. Plus, cover crops had been standard in Pennsylvania, because they kept rains from washing nutrients from fertilized fields into Chesapeake Bay. "In western Kansas, cover crops are not common," McCarty says. "Water is scarce and a declining resource, and people historically viewed cover crops as a drain on water. Research shows it can help you capture more water, but it's hard to break old ideas." Then, about six years ago, the McCartys contracted to supply milk to Danone North America—makers of Dannon yogurt—which, as part of a broader sustainability effort, has pledged to become carbon-neutral by 2050. The McCartys also committed to produce non-genetically modified goods. That meant staying connected to their cows' food. They began planting cover crops in earnest. Danone didn't require the McCartys to adopt particular practices. "But they encourage, through a variety of means, the adoption, sharing and utilization of best practices in all aspects of our farm management," McCarty says. The arrangement gives the dairy price stability. When times are tough—especially on dairies, 90 percent of which are family-owned—that makes a world of difference. "The farm economy has been challenging for a number of years," McCarty says. "When you're fighting for sheer survival, it's difficult to think about 'value added' products." Most American farmers, he adds, are much older than he is. At 36, he’s the youngest of four McCarty boys. "The average age of the American farmer is up there, and often-times the belief in climate change and the willingness to try new practices is more common in younger generations," McCarty says. "All we have to do is start" Extending a carbon tax credit like the one Congress passed this year to farms and timber owners might make a difference "That would be incredibly helpful," McCarty says.

The value of incentives to drive innovation is no secret. That's how renewable power went from a **niche** product **to** an **energy staple in** little more than **eight years.**

"Why is wind and solar so cheap? Because **subsidies created a marketplace where capitalism could do its magic**," Pacala says. Creating a similar marketplace for negative emissions while decarbonizing the economy could **bring rapid change.**

**2] Warming causes extinction – a confluence of nonlinear and unpredictable effects will make human and natural systems inhospitable while increasing escalatory conflicts – even if the impacts are far off, only drastic action now solves**

**Melton 19** [Michelle Melton is a 3L at Harvard Law School. Before law school, she was an associate fellow in the Energy and National Security Program at the Center for Strategic and International Studies, where she focused on climate policy. Climate Change and National Security, Part II: How Big a Threat is the Climate? January 7, 2019. https://www.lawfareblog.com/climate-change-and-national-security-part-ii-how-big-threat-climate]

At least until 2050, and possibly for decades after, climate change will remain a **creeping threat** that will **exacerbate and amplify** existing, **structural** global **inequalities**. While the developed world will be negatively affected by climate change through 2050, the consequences of climate change will be felt most acutely in the developing world. The national security threats posed by climate change to 2050 are likely to differ in degree, not kind, from the kinds of threats already posed by climate change. For the next few decades, climate change will **exacerbate humanitarian crises**—some of which will result in the deployment of **military personnel**, as well as material and financial assistance. It will also **aggravate** natural **resource constraints**, potentially contributing to political and economic **conflict** over **water**, **food** and **energy**. The question for the next 30 years is not “can humanity survive as a species with 1.5°C or 2°C of warming,” but, “how much will the existing disparities between the developed and developing world widen, and how long (and how successfully) can these widening political/economic disparities be sustained?” The urgency of the climate threat in the next few decades will depend, to a large degree, on whether and how much the U.S. government perceives a widening of these global inequities as a threat to U.S. national security. By contrast, if emissions continue to **creep upward** (or if they do not decline rapidly), by 2100 climate-related national security threats could be **existential**. The question for the next hundred years is not, “are disparities politically and economically manageable?” but, “can the **global order**, premised on the **nation-state system**, itself based on territorial sovereignty, **survive** in a world in which **substantial swathes of territory** are potentially **uninhabitable**?” National Security Consequences of Climate Change to 2050 Scientists can predict the consequences of climate change to 2050 with some measure of certainty. (Beyond that date, the pace and magnitude of climate change—and therefore, the national security threat posed by it—depend heavily on the level of emissions in the coming years, as I have explained.) There is relative agreement across modeled climate scenarios that the world will likely warm, on average, at least 1.5°C above pre-industrial levels by about 2050—but perhaps as soon as 2030. This level of warming is likely to occur even if the world succeeds in dramatically reducing greenhouse gas emissions, as even the recent Intergovernmental Panel on Climate Change (IPCC) report implicitly admits. In other words, a certain amount of additional warming—at least 1.5°C, and probably more than that—is presumptively unavoidable. Looking ahead to 2050, it can be said with relative confidence that the national security consequences of climate change will vary in degree, not in kind, from the national security threats already facing the United States. This is hardly good news. Even **small differences** in global average **temperatures** result in **significant environmental changes**, with attendant **social**, **economic** and **political consequences**. By 2050, climate change will **wreak increasing havoc** on **human** and **natural systems**—predominantly, but not exclusively, in the developing world—with attenuated but **profound consequences** for **national security**. In particular, changes in **temperature**, the **hydrological cycle** and the **ranges of insects** will impact **food availability** and food access in much of the world, increasing food insecurity. **Storms**, **flooding**, **changes in ocean pH** and other climate-linked changes will damage **infrastructure** and negatively impact **labor productivity** and economic **growth** in much of the world. Vector-borne **diseases** will also become **more prevalent**, as climate change will expand the geographic **range** and **intensity** of **transmission** of diseases like malaria, West Nile, Zika and dengue fever, and cholera. Rising **public health challenges**, **economic devastation** and **food insecurity** will translate into an increased **demand** for **humanitarian assistance** provided by the **military**, increased **migration**—especially from tropical and subtropical regions—and **geopolitical conflict**. Long-term trends such as declining food security, coupled with short-term events like hurricanes, could sustain unprecedented levels of migration. The 2015 refugee crisis in Europe portends the kinds of population movements that will only accelerate in the coming decades: people from Africa, Southwest and South Asia and elsewhere crossing land and water to reach Europe. For the United States, this likely means greater numbers of people seeking entry from both Central America and the Caribbean. Such influxes are not unprecedented, but they are unlikely to abate and could increase in volume over the next few decades, driven in part by climate change-related food insecurity, climate change-related storms and also by economic and political instability. Food insecurity, economic losses and loss of human life are also likely to exacerbate existing political tensions in the developing world, especially in regions with poor governance and/or where the climate is particularly vulnerable to warming (e.g., the Mediterranean basin). While the Arab Spring had many underlying causes, it also coincided with a period of high food prices, which arguably contributed to the protests. In some situations, **food insecurity**, **economic losses** and **public health crises**, combined with **weak** and ineffectual **governance**, could **precipitate future conflicts** of this kind—although it will be difficult to know where and when without more precise local studies of both underlying political dynamics and the regionally-specific impacts of climate change. 2100 and Beyond While the national security impacts of climate change to 2050 are likely to be costly and disruptive for the U.S. military—and devastating for many people around the world—at some point after 2050, if warming continues at its current pace, changes to the climate could **fundamentally reshape geopolitics** and possibly even the current nation-state basis of the current global order. To be clear, both the ultimate level of warming and its attendant political consequences is highly speculative, for the reasons I explained in my last post. Nonetheless, we do know that the planet is currently on track for at least 3-4°C of warming by 2100. The “known knowns” of higher levels of warming—say, 3°C—are frightening. At that 3°C of warming, for example, scientists project that there will be a nearly **70 percent decline** in **wheat** production in **Central America** and the Caribbean, **75 percent** of the **land area** in the **Mid**dle **East** and more than 50 percent in South Asia will be affected by highly unusual heat, and **sea level rise** could **displace** and imperil the lives **hundreds of millions** of people, among other consequences. But even higher levels of warming are physically possible within this century. At these levels of warming, some **regions of the world** would be **literally uninhabitable**, likely resulting in the depopulation of the tropics, to say nothing of the consequences of **sea-level rise** for **economically important cities** such as Amsterdam and New York. Even if newly warmed regions of the far north could **theoretically accommodate** the resulting **migrants**, this **presumes** that the **political response** to this unprecedented **global displacement** would be **orderly** and **conflict-free** **borders on fantasy**. The geopolitical consequences of significant levels of warming are severe, but if these changes occur in a linear way, at least there will be time for human systems to adjust. Perhaps more challenging for national security is the possibility that the until-now **linear changes give way** to **abrupt** and **irreversible ones**. Scientists forecast that, at higher levels of warming—precisely what level is speculative—humanity could trigger **catastrophic**, **abrupt** and **unavoidable consequences** to the **ecosystem**. The IPCC has considered **nine** such abrupt changes; one example is the potential **shutting down** of the **Indian summer monsoon**. Over a **billion** people are **dependent** upon the Indian monsoon, which provides parts of South Asia with about 80 percent of its annual rainfall; relatively minor changes in the monsoon in either direction can cause disasters. In 2010, a wetter monsoon led to the catastrophic flooding in Pakistan, which directly affected 20 million people; a drier monsoon in 2002 led to devastating drought. Studies suggest that the Indian summer monsoon has two stable states: wet (i.e., the current state) and dry (characterized by low precipitation over the subcontinent). At some point, if warming continues, the monsoon could abruptly shift into the second, “dry” state, with catastrophic consequences for over a billion people dependent on monsoon-fed agriculture. The IPCC suggests that such a state-shift is “unlikely”—that is, there is a 10 to 33 percent chance that a state-shift will happen in the 21st century—but scientists also have relatively low confidence in their understanding of the underlying mechanisms in this and other large-scale natural systems. The consequences of abrupt, severe warming for national security are obvious in general, if unclear in the specifics. In 2003, the Defense Department asked a contractor to explore such a scenario. The resulting report outlined the offensive and defensive national security strategies countries may adopt if faced with abrupt climate change, and highlighted the **increased risk** of inter- and intra-state **conflict** over natural **resources** and **immigration**. Although the report may be off in its imagined timeframe (positing abrupt climate change by 2020), the world it conjures is improbable but not outlandish. If the Indian monsoon were to switch to dry state, and a billion people were suddenly without reliable food sources, for example, it is not clear how the Indian government would react, assuming it would survive in its current form. Major wars or low-intensity proxy conflicts seem likely, if not inevitable, in such a scenario. This is not to say that a parade of climate horribles is certain—or even likely—to come to pass. Scientific understanding of the sensitivities in the climate system are far from perfect. It is also possible that emissions will decline more rapidly than anticipated, averting the worst consequences of climate change. But this outcome is far from guaranteed. And even if global emissions decline precipitously, humanity cannot be sure when or whether the planet has crossed a climate tipping point beyond which the incremental nature of the current changes shifts from the current linear, gradual progression to a non-linear and abrupt process. Within the next few decades, the most likely scenario involves manageable, but costly, consequences on infrastructure, food security and natural disasters, which will be borne primarily by the world’s most impoverished citizens and the members of the military who provide them with humanitarian assistance and disaster relief. But **while** the head-turning national security **impacts** of climate change are **probably** several **decades away**, the **nature of the threat** is such that **waiting until** these **changes manifest** is **not a viable option**. By the time the climate consequences are severe enough to compel action, there is likely to be little that can be done on human timescales to undo the changes to **environmental systems** and the **human societies dependent upon them**.

#### 3] Voting for the aff takes too long – vote neg to solve the aff’s impacts. They can’t solve warming.

#### 4] Space exploration key to scientific innovation

Keusen 21 Tanya, "Space Exploration and Innovation," United Nations Office for Outer Affairs, https://www.unoosa.org/oosa/en/ourwork/topics/space-exploration-and-innovation.html

Since the beginning of time, exploring the Universe has been a dream of humankind. Human curiosity has fuelled interest in exploring and discovering new worlds, pushing the boundaries of the known, and expanding scientific and technical knowledge. States and [space agencies](https://www.unoosa.org/oosa/en/ourwork/space-agencies-OLD.html) have been engaging in space exploration since the first space launch. The first space launch led to the first human space flight, which led to the first moonwalk. Nowadays focus has shifted to joint human and robotic missions, near-Earth asteroids, Mars and destinations beyond our own solar system. Space exploration and the innovation it entails are essential drivers for opening up new domains in space science and technology. They trigger new partnerships and develop capabilities that create new opportunities for addressing global challenges. Space exploration also motivates young people to pursue education and careers in science, technology, engineering and mathematics (the STEM disciplines). Though the precise nature of future benefits from space exploration is not easily predefined, current trends suggest that significant advantage may be found in areas such as new materials, health and medicine, transportation and computer technology. As the benefits of space exploration and innovation become better known, increasingly more countries and non-governmental entities are interested in engaging in exploration and innovation. Recent COPUOS and UNOOSA Efforts In 2016, seven thematic priorities were endorsed by the Committee on the Peaceful Uses of Outer Space in the context of preparations for the fiftieth anniversary of the United Nations Conference on the Exploration and Use of Outer Space (UNISPACE+50), the first of which was global partnership in space exploration and innovation. The Committee established an action team as the mechanism to drive the topic. Twenty-two States and seven permanent observer organizations joined the [Action Team on Exploration and Innovation](https://www.unoosa.org/res/oosadoc/data/documents/2018/aac_105c_12018crp/aac_105c_12018crp_3_0_html/AC105_C1_2018_CRP03E.pdf), producing a report including a series of recommendations ( [A/AC.105/1168)](https://www.unoosa.org/oosa/en/oosadoc/data/documents/2018/aac.105/aac.1051168_0.html). The Action Team Co-Chairs underscored the significance of the report, "which represented the first time the United Nations had examined, in a comprehensive way, human and robotic exploration beyond low-Earth orbit, and provided a basis for further consideration of how the United Nations system may contribute to a new era in the peaceful exploration and use of outer space". In 2018, on the basis of the Action Team recommendation, the Committee added "Space exploration and innovation" as an item on its agenda ( [A/73/20](https://www.unoosa.org/oosa/en/oosadoc/data/documents/2018/a/a7320_0.html), para. 364). Under this agenda item, first considered at the Committee session in 2019, States share information on, among other things: research and development activities; astronaut programmes; a space exploration innovation hub centre; the planned establishment of a Mars scientific city; activities in connection with the International Space Station and the China Space Station; the use of a satellite as a multi-wavelength observatory; various missions to the Moon, Mars, Venus, Jupiter and asteroids; the planned Lunar Orbital Platform-Gateway; a new spacecraft that has the potential to be utilized as a deep-space logistics carrier to the cis-lunar region; a dedicated solar mission with a focus on studying the inner solar corona; a tracker of electromagnetic counterparts of binary neutron star merger events; a mission to examine the atmospheric composition of exoplanets; and satellites launched for the purpose of deep space exploration. Much of this information is available in [technical presentations](https://www.unoosa.org/oosa/en/ourwork/copuos/technical-presentations.html).

### extra case turn cards

#### Informatics and technology mitigate existential risks such as climate change

Branch ’10 - Ph.D., Educational Research and Policy Analysis, North Carolina State University (Benjamin D.; “Educational Leadership’s Literacy Needs for Informatics and Cybernetics Agenda”; http://www.iiis.org/CDs2010/CD2010IMC/ICETI\_2010/PapersPdf/EB465UI.pdf)//TS

At the heart of many forms of societal change is leadership that is aware of the necessary change that may best suit emerging technological paradigms. However, the informatics and cybernetics agenda is one that may be unknown in policy on the federal and many state levels towards educational K-12 value. Specifically, Executive Order 12906, a federal mandate known as the Coordinating Geographical Data Acquisition and Access: The National Spatial Data Infrastructure, by the federal government in 1994 has interested educators in exploring their possible roles in spatial thinking, broadly defined as the use of space to define, formulate and solve problems (Branch, 2009). As such, literacy towards informatics and cybernetics may be needed to stimulate such pipeline considerations by next generation educational leadership (NGEL). Thus, educational leaderships literacy towards informatics and cybernetics may need to be an intentional interdisciplinary collaboration of change where issues of climate change and a green economy are injected into a K-12 data experience which could possibly address the NCLB (2001) mandate and to increase mandated geosciences outcomes. Such state compliance to Executive Order 12906 is coordinated by the National States Geographic Information Council (Branch, 2009). Moreover, educational leadership is directed to ensure such data driven activity occurs within its infrastructure, because in most cases a state‟s department of education has to compliance like all other state agencies as a state seeks compliance with the federal Executive Order 12906. This work may serve as a brick in the new educational foundations of NGEL. Such proclaims that leadership must have pragmatic solutions and refrain from political rhetoric. NGEL should address, represent and bridge pragmatic solutions to long standing educational issues left behind due to a lack of effective interaction between communities, school leadership, such policy makers and the scientific community. Lastly, this work may imply that informal and formal community informatics and citizen science programs may be the plausible venues to address Science, Technology, Engineering and Math (STEM) outcomes. In addition, this paper focuses on Earth Science and space informatics as K-12 literacy need because it linked as outcome of the STEM outcome as defined by the United States Department of Education. Thus, the terms informatics and cybernetics are assumed to be linked to Earth Science and space concepts. For example, as the [1] National Academy of Sciences (2006) defined spatial thinking as an likely medium of scientific communication for all levels of education, the stakeholders in control may develop a new age literacy and involvement towards [2] Executive Order 12906, state mandates, the societal needs of climate change and a green economy. At the root of such effectiveness is what infrastructure and what type of investment in such infrastructures will cost effectively benefit society. As school districts are hit with budget crises, informatics and cybernetics have to re- define themselves into cost effective and pragmatic community based frameworks that support an interdisciplinary ontology of communication across disciplines as referenced in [3] knowledge representation in the semantic web for Earth and environmental terminology (SWEET). Such may be a defining collaborative skill development towards a global citizen mindset. Such a definition should be considered a NGEL literacy for the global citizen of tomorrow which is illustrated in this conceptual framework in Figure 1. Figure 1 [3] SWEET 2.0 In the [3] SWEET implementation, math may be the root of relating the value of informatics or cybernetics across disciplines. Hence, data processes along with Earth Science investigations may need a synergistic value and intentional support by NGEL to sustain K-12 implementation and assessment. The foresight of education leadership should have the ability to always define or anticipate the next generation of pedagogical need of its impending data and infrastructure requirements. For example, if grid or cloud computing becomes an cost effective norm in society, then perhaps education should consider a bee hive approach to societal needs where the entire society must input a more equitable role in the brainpower of its citizens to address future climate change and green economy needs. Simply, if informatics and cybernetics are critical to climate change response, then data driven practices along with computational Earth Science training must be a common occurrence. Hence, educational networks must transfer more knowledge in future generations. For example, National Aeronautical and Space Administration‟s (NASA) Cryosphere and Dynamic Earth public outreach materials suggest a 3-foot sea level rise by 2100 A. D. that may affect millions of persons in the world. If the potency of effective educational leadership does not have spatial thinking, informatics and cybernetics development on its radar, then how can it steer future generation towards a state of self determination in the face of a complex world where Earth Science data computation is a valuable commodity? Therefore, society may be challenged with a spatial thinking literacy as well as an informatics and cybernetic literacy. Clearly, “the spatial thinking experience of data collection, data verification, and data analysis is not on the radar of educational leadership” [4] (Branch, 2009). As such, informatics literacy and cybernetics literacy may too be nonevolved within the educational K-12 community. This paper suggests that applicable policy exists for spatial literacy to be embraced and supported from [2] 1994 Executive Order 12906. Such is the basis for literacy towards informatics and cybernetics to take root in the K-12 experience after projected based spatial thinking or Earth Science base experienced reach the K-12 standard course of study. This work argues that after school experiences are not enough to prepare the next generation of global citizens to deal with the green economy or climate change implications. The [5] 2009 White House “Educate to Innovate” campaign by the Obama administration should address the K-12 standard course of study on the state level and supported by the US Department of Education because of [2] Executive Order 12906. Furthermore, since past Presidential Initiatives such as Bush administration‟s 2005 support of geospatial technology in the K-12 and college community should not be ignored. The states and the federal government laws applicable to [2] Executive Order 12906 should provide rationale for educational leadership and NGEL to ensure spatial literacy applied to the K-16 standard course of study. Literacy towards informatics and cybernetics by educational leadership may be a secondary response to [2] Executive Order 12906. NGEL should utilize the practice of community informatics, a collection of community remote sensing, community geographical information systems and environmental study, where cost effective Earth Science could be implemented by partnership between educators and the community. Here, a literacy of climate change is justified in the terms and practices of informal to formal Earth Science data collection, analysis and presentation with cost effective Earth Science tools of GIS, remote sensing or Earth Science investigation. Successful implementations may even become applicable solution to economically stricken school districts. Moreover, a possible benefit to government agencies could be stimulation in STEM disciplines outcome in a cost effective manner if collaboration between academic institutions, the community and scientific agencies desire such synergy. Moreover, implications to Earth Science and Space informatics pipeline, climate change, interdisciplinary research and collaboration; accreditation change, and grant funding issues should be well versed by educational leadership to address the data driven needs and skills of next generation considerations of global citizens. NGEL has a morale obligation to create the next global competitive citizens with literacy in spatial tools, Earth Science data processes, climate change debate and logistics of a global economy