THE FINAL FRONTIER OF GLOBAL SOCIETY AND THE EVOLUTION OF SPACE GOVERNANCE

Eytan Tepper*

Abstract

This chapter discusses the impact of space exploration and utilization on global society and globalization. Globalization, with its cross-border interconnection, interdependence, and engagement, increases the need for supra-national regulation, i.e. global governance. The chapter, therefore, continues with a review of global space governance and how it evolves over time. Space applications have revolutionized communication and transportation, facilitating the interconnections that drive globalization. The original monocentric system of space governance is stagnating since the 1970s and fails to keep up with the technological, and commercial developments. The only way forward is by the evolution of separate, issue-specific governance centers and legal instruments (regimes), conforming to common basic principles. Thus, the issue of militarization will have a separate forum and legal instruments that conforms to the Outer Space Treaty. Together, these regimes, will incrementally build a decentralized – and updated - space governance. In fact, space governance is already on track to become decentralized. Looking down the road, space habitation will be the most important spatial expansion since humans spread from Africa, with implications also to those left behind on Earth. And if the ongoing search for extra-terrestrial intelligence ever results in detection, it will affect our lives and cognition.

---

* McGill University, Institute of Air and Space Law

Citation:

Eytan Tepper, *'The Final Frontier of Global Society and the Evolution of Space Governance'*, in CHALLENGES OF GLOBALIZATION AND PROSPECTS FOR AN INTER-CIVILIZATIONAL WORLD ORDER (Ino Rossi ed) (Springer 2020)

Contents

1 Introduction

Space exploration and utilization brought about many applications, notably satellite-based communication and navigation. Space applications are long drivers of globalization and they are on track to revolutionize human life on earth and beyond in ways we still do not fully know. Spatial expansion, migration and technological breakthroughs were always milestones in human evolution. Space exploration and utilization engulf both these types of revolutions in human life with (i) new technologies and space applications and (ii) expansion and migration to new territories. Space applications promoted globalization by enabling faster, cheaper and safer transportation, and by making communication across the globe swift and low cost. These applications, together with technological advancement in other fields, notably computer and internet technologies, bridge geographic distances and make the world smaller in many aspects. New space applications said to be introduced in the coming years or decade will make the world ever smaller, further promoting globalization. These include suborbital

flights that will reduce the duration of cross-Atlantic flights to one hour and constellations of small satellites that will provide broadband internet everywhere on Earth, not depending on ground infrastructure.

Activities performed within the territory of a nation-state are bound by the domestic laws of this state as well as by its governance mechanisms. However, activities that cross national boundaries, like international trade, or are performed beyond any national jurisdiction, e.g. in the open seas and outer space that are not part of the territory of any state, require regulation at the supranational level. International law and global governance provide such supranational regulation, however, absent a global government or supreme authority – the state of anarchy in international relations – they do so with a limited, though still substantial, success. The governance of space activities has a solid base, with several widely accepted space law treaties and dedicated UN organs. However, due to political gridlock, this base, introduced in the 1960s-1970s, has largely remained unchanged, and space governance fails to keep up with the technological, engineering and commercial developments of space exploration and utilization. While some sectors are well regulated – e.g. the placement and operation of communication satellites – others – e.g. military uses of space - are hardly regulated. Geopolitics still plays a role in space activities and, despite space once perceived as the place in which national rivalries will be put aside - the role of states is even increasing. Space governance is becoming decentralized and eclectic, varying across sub-issue-areas (i.e. specific issue-areas within the issue-area of space activities, such as militarization of space and space debris): while some sub-issue-areas exhibit a well-developed and organized multilateral regime, others exhibit a partial and voluntary regime complex and yet others hardly any at all, with recourse to national actions. The governance deficit may bring – and perhaps already brought – a space arms race and insufficient address of the problem of space debris. It also brings about reliance on national legislation with regards to space mining. To date, space governance is Earthbound and suffers from the maladies of global politics. The breakthrough will come when, way down the road, space colonies will be self-sufficient and adopt governance systems independent from Earth.

Looking further down the road, space habitation will have a profound impact on humanity. Human migration to new territories has through history had a profound impact on humanity – on those who emigrate and the societies they create, join or subordinate, and, potentially, on those left behind. The great migration to North America resulted in the creation of the US which long has a critical influence on Europe and the other places from which migrants came

to the US. We can only start to contemplate the ramifications for global society from the colonization of space and from the discovery of extra-terrestrial intelligence, should that ever materialize. Existing theories of criminology may not explain deviant behavior of astronauts and crimes in space in general. It is possible that future study of social sciences in space will result in new theories that apply to social sciences phenomena in space (e.g. crimes in space, governance in space), theories different to a certain extent from theories that may adequately explain social sciences phenomena on earth.

Space exploration and utilization bring global society to new frontiers of globalization, and it is on track to take it one notch beyond the known frontiers.

2 Space applications as drivers of globalization

Space applications, especially telecommunications, global navigation, and Earth observation, play a vital role in the process of globalization. Globalization is the process by which the world moves toward an integrated global society and the significance of national borders decreases (Zürn, 2013). It is a result of the interconnections and interdependence of and across human societies that is facilitated by the developments of communication, transportation and computer technology that bridge geographic and cultural distances. The four main types of satellites are communications, remote sensing, navigation, and meteorology (Pelton, Madry, & Camacho-Lara, 2017). Space applications and their uses are numerous, including communication and data transfer, navigation, meteorology (weather forecast), disaster warning and management (e.g. earthquakes, storms), remote sensing including Earth observation, tracking, and logistics. They even influence international diplomacy (Bjola, 2017; Bjola & Holmes, 2015). Nevertheless, I will focus herein on their effect on transportation and communication, the drivers of globalization.

2.1 Transportation revolutionized

Space applications have revolutionized transportation, whether international or domestic, maritime, air, rail, and road. By that they also revolutionized logistics. Global Navigation Satellite Systems (GNSS) provide accurate and easy positioning, navigation and timing (PNT) (Hofmann-Wellenhof, Lichtenegger, & Wasle, 2007). The US' GPS system is the widely known and used GNSS, but there are other global or regional GNSS systems in various stages of erection and use – Russia's GLONASS, China's BeiDou, Europe's Galileo, India’s NAVIC and Japan’s QZSS. GNSS-enabled services transformed, *inter alia*, mass transportation of people and goods. GNSS applications transformed marine transportation by providing ships

with an easy, fast and accurate way to determine their position, speed and direction and to navigate to their destination. They have greatly improved railroad transportation, being used to track trains in real-time, increasing safety and operational effectiveness. Road travel became easier and more effective with the use of navigation applications and the operation of car fleets is more efficient using positioning applications for real-time tracking of the various vehicles. GNSS applications are likewise used in aviation, allowing pilots and air traffic control to track, in real-time, the position of aircrafts and to navigate them easily and securely to their destination. GNSS, notably GPS, is used in every type of transportation, making it easier, faster, safer and more efficient and therefore also cheaper.

Space flight, long a venerable industry, has become profitable, with private companies like SpaceX providing launch services placing satellites in orbit, sending payloads to the ISS and soon also carrying humans to Earth orbit and beyond. A new mode of flights developed by the space industry - suborbital flights - carry a promise to dramatically decrease travel duration. Suborbital flights will take off or launch (depending on the technology), reach the edge of space (the Kármán line, about 62 miles /100 km above sea level) and then plummet towards their destinations on earth. A cross-Atlantic suborbital flight would last an hour and a New York – Beijing suborbital flight two hours. Amazon founder Jeff Bezos' Blue Origin, Richard Branson's Virgin Galactic and X-Cor are prominent actors in this industry. While 2019 may see the first commercial suborbital flights (Foust, 2018), the initial cost – US$ 100,000 – 250,000 – means it is still not a viable alternative except for the ultra-rich. However, if prices fall significantly, it will revolutionize long-distance transportation and human life in general. If Sydney is a 1-2 hours flight away from London or New York, geography will mean different things than it does now. Reasonably priced suborbital flights may change where people live and work and drive deeper globalization. UBS, the Swiss multinational investment bank, published a report suggesting that within a decade the market for high speed travel via outer space will surpass US$20 billion annually and it will compete with long-distance airline flights (Sheetz, 2019). Like with many technologies, there are adverse effects, including regarding privacy. The EU has established "the right to be forgotten", a person's right to have information on her removed from the internet[1]. However, there is yet no "right to be lost", a right not to be tracked. Each of us carrying a smartphone

[1] Initially by the Court of Justice of the European Union in the case of *Google Spain SL and Google Inc. v Agencia Española de Protección de Datos (AEPD) and Mario Costeja González*, 2014 and subsequently in Article 17 of the EU's General Data Protection Regulation (GDPR) (General Data Protection Regulation (GDPR), 2016) titled "Right to erasure ('right to be forgotten')".

shares hers/his whereabouts *in any given moment* with Google, Apple and other, perhaps less friendly, organizations or governments. Indeed, "the ability to track individuals on a continual basis also raises important societal, ethical, and legal implication" (R. Jakhu & Pelton, 2017a, p. 194). For better or for worse, GNSS systems are critical to military operations and are usually sponsored and operated by the defense administration, in the case of the US – by the Department of Defense (DoD).

2.2 Telecommunication revolutionized

Communication satellites revolutionized telecommunication and space-based communications is long a viable and profitable industry. Satellite-based telecommunication was the first space sector to commercialize, starting from the 1960s, and become a profitable industry (R. Jakhu & Pelton, 2017b; Pelton, 2012; Pelton et al., 2017). Around 2,000 such satellites orbit Earth relaying analog and digital signals carrying voice, video, and data. They are connecting an enormous number of locations worldwide, including ground stations and home satellite dishes. Communication satellites are used for Radio and TV broadcasting, for voice communications and for data transfer, including the provision of internet connection to places with insufficient infrastructure. Using satellites, communication has become swift and low cost. The ability to deliver images across the world, and broadcast news events to viewers worldwide, enables them to know in real-time on developments everywhere and participate in the joy, anxiety or mourning on those events. This, in turn, creates shared experiences for people worldwide who become a little bit more of a global society. Furthermore, there is synergy with other space technologies, e.g. digital photography. Digital photography was invented for space exploration and is long in the center of our ability to instantly take pictures and video and send them to the other side of the globe at low or even zero cost. With an analog camera, it would take 1-2 weeks and cost dozens of dollars for the film, its development and shipment by snail mail (but we would hardly do that for this reason). We cannot imagine globalization without the option to make a voice, video or even a video-conference call with people on the other side of the world instantly, constantly, and with low cost, or even for free. Indeed, “[t]he capacity to communicate around the world and into space almost instantaneously is a technological achievement that makes global cultural integration not merely possible but inevitable” (Wolfe, 1979).

The communication revolution is not over. Within 2-5 years, constellations of hundreds of small satellites are about to provide broadband internet connection to nearly every point on earth, connecting many currently unserved or under-served users. The leading actors here are

OneWeb, financed by a consortium of deep-pocketed investors, and Elon Musk' SpaceX (Forrester, 2018). The service will soon bring the internet and connectivity revolution to remote and so far disconnected parts of Earth and drive deeper globalization.

2.3 Affordable access to space applications

CubeSats, or cube satellites, are the equivalent of the evolution from mainframe computers to smartphones (Kane, 2013). Regular size satellites weigh hundreds of kg to several tones, span meters to dozens of meters and cost US$ hundreds of millions to purchase and launch to earth orbit. Smallsats are smaller and cheaper, nanosatellites even more and CubeSats the smallest so far. CubeSats are miniature satellites, a 10-centimeter (4-inch) cube with a mass of fewer than 1.33 kilograms (2.93 lbs.) (NASA, 2017). With a cost to orbit of less than US$ 100,000 (Selva & Krejci, 2012) and availability for purchase as a kit[2], they make remote sensing and satellite communication accessible to mid-size firms, universities, and many other new users. Hundreds of CubeSats have already been successfully deployed in Earth orbit in the past 15 years and they provide ongoing and relatively inexpensive access to space applications with a life span of anywhere from weeks to five years. Initially used primarily for education and capability demonstration, they were later put to use for scientific missions by NASA and other actors as they are now capable of performing functions of Earth observation missions, including disaster monitoring (Selva & Krejci, 2012). CubeSats raise substantial concerns for orbital crowding and space debris (R. Jakhu & Pelton, 2017b) and questions as to their regulatory status (R. S. Jakhu & Pelton, 2013). Yet, they provide a simple and cheap option for Earth photography and they are making orbital experiments affordable to even the smallest research groups and were therefore called “citizen satellites” (Pang & Twiggs, 2011).

2.4 Uses of space that thwart globalization

To be sure, space applications can and are also used for ideas and activities that thwart globalization. The communication that runs through satellites includes a spectrum of ideas, including those questioning globalization. In addition, space applications are already part of warfare, e.g. with the use of satellite imaging of enemy forces, satellite communication, GPS guided missiles, GPS-based tracking and positioning of aircrafts and vehicles. Indeed, "technologies for intelligence, reconnaissance, surveillance, and communication purposes have become fully integrated into military operations on Earth” (R. Jakhu & Pelton, 2017b). Moreover, with the development of space weapons and a threat of militarization of space,

[2] See http://www.cubesatkit.com.

space warfare cannot be ruled out (Blake, 2014; Dawson, 2019; Klein, 2012). Yet, all these contra-globalization forces are using space applications for previously held ideas and rivalries. In contrast, the new capabilities in transportation and communication are independent – and powerful – drivers of globalization. While satellite communication spreads ideas that support and oppose globalization, by making the world smaller the net effect of space applications is a new level of globalization.

2.5 Capabilities drive globalization

Technological developments drive globalization at least as much as global politics (e.g. wars and their aftermath) and zeitgeist do. Globalization is to a large extent the result of the Information and Communications Technology (ICT) revolution, particularly the wave of globalization of the late 19th and early 20th century. Globalization is as much about capabilities as it is about ideas. Give humans capabilities and they will exploit them. At the same time, ideas bring about the new capabilities in computer and internet technology and certainly in space exploration. Space exploration and utilization, and its resulting space applications, provide the capabilities that sprung deeper levels of globalization and promise to bring yet another wave of globalization. The cumulative effects are key to globalization, and of no less importance than trade agreements and international institutions like GATT, WTO, IMF and the World Bank. Their combined effect is the legal, institutional and physical infrastructure of globalization.

3 The evolution of space governance over time

Globalization, with its cross-border interconnection, interdependence, and engagement, increases the need for supra-national regulation, i.e. for global governance. Global governance is the process by which the repertoire of norms and rules that guide the behavior of actors in global affairs is established, implemented and reformed.[3] The main building blocks of global governance are norms, rules, policies, institutions and fora that all influence the behavior of the actors in global affairs. Global space governance, or space governance, is what guides the behavior of actors in space affairs and the execution of space activities. The main building blocks of space governance include a dedicated UN committee and office and five space law treaties which were introduced in a 20 years' span pursuing the launch of the first artificial earth satellite, Sputnik1, by the Soviet Union on October 4, 1957. However, no

[3] Compare these influential definitions of "global governance": (Governance, 1995; Rosenau, 1995; United Nations Development Programme (UNDP), 1999; Weiss & Thakur, 2010).

new space law treaty was adopted since 1979, none is expected in the foreseeable future and even non-legally-binding understandings are difficult to achieve, let alone enforce. Space governance is in critical need of an update and it becoming decentralized is the only hope for such an update.

3.1 The evolution of space law and governance

Space law and space governance apply to space activities – those performed on Earth and especially those performed beyond Earth, in space. The application of space law to activities in space is extra-territorial, as space may not become the territory of any country, and extra-terrestrial, being beyond Earth. Soon after the Soviet launch of the Sputnik1, the two superpowers of the Cold War, the US and the Soviet Union, led an effort to establish basic principles and rules for the exploration and use of outer space. In 1959, the UN established the UN Committee on the Peaceful Uses of Outer Space (UN-COPUOS), still to date the main multilateral forum to discuss and address all issues relating to space exploration and utilization, and which holds yearly sessions. The United Nations Office for Outer Space Affairs (UN-OOSA), in addition to serving as the secretariat of UN-COPUOS, is very active on capacity building initiatives around the world. The US and the Soviet Union led the discussions leading to the adoption of the first space law treaties, with UN-COPUOS playing an instrumental role. The 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (OST) (Outer Space Treaty, 1967) is, to date, the most important legal instrument on space law. It introduced the basic principles and rules that are to date the basis of space law and governance. Three more treaties are an elaboration on specific OST provisions on the rescue of astronauts and space crafts (Rescue Agreement, 1968), liability (Liability Convention, 1972) and registration of space objects with the UN (Registration Convention, 1974). The fifth and last space law treaty is an agreement on the utilization of natural resources on celestial bodies in the solar system (Moon Agreement, 1979). However, this treaty, unlike the previous four, failed to gain wide support with less than 20 states ratifying it, and none of the major spacefaring nations (UN Committee on the Peaceful Uses of Outer Space, 2018). As a result, only the first four treaties bind most of the actors in space.

The Moon Agreement was the last space law treaty to be adopted and none is expected in the foreseeable future. It is fair to say that the ability to adopt legally binding multilateral regimes on space exploration and use have been lost as of ~~1975~~ the 1970s. There were attempts to adopt ‘soft law’, i.e. non-legally binding instruments such as ‘guidelines’, instead of legally

binding treaties. Such were the guidelines on space debris (Space Debris Mitigation Guidelines, 2007) However, they failed to prevent a sharp increase in space debris soon after their introduction and by states party to the preparation and adoption of the guidelines (ESA, 2018). Moreover, another attempt to introduce another soft law instrument, the International Code of Conduct for Outer Space Activities, failed after almost a decade of work since 2006.

There are several treaties and organizations that are, in part, related to space activities. The Partial Test Ban Treaty bans nuclear weapon tests in outer space, as well as in the atmosphere and under water (Partial Test Ban Treaty, 1963). The International Telecommunication Union (ITU) administers the slots in orbit around Earth and radio frequencies used, inter alia, to communicate with satellites.

3.2 The crisis in space governance

Since the dawn of the century, the commercial sector has quickly expanded, and it has already taken the lead from national space agencies. In what is known as "New Space", the commercial sector has made access to space easier and cheaper. It enhances the capabilities and uses of existing space applications and develops new ones, including many disruptive or game-changing applications. The new developments in space exploration and utilization are pushing the boundaries of space law and putting a strain on the outed system of space governance, which is in dire need to evolve to accommodate and regulate the new space activities. While the adoption of new space law treaties or the amendment of the old ones is no longer feasible, space governance can evolve in several parallel different paths.

In this regard, space governance is part of a long and escalating trend in global affairs of retreat from binding multilateral arrangements. Anarchy - the absence of a world government or supreme authority - is the basic condition of global politics that define the study of international relations (Lechner, 2017a, 2017b; Milner, 1991). International politics in general sees diffusion of power, difficulty to establish and even maintain multilateral arrangements as States strategically refrain from binding multilateral regimes (Benvenisti & Downs, 2007) and multilateralism, in general, being contested (Morse & Keohane, 2014). Global governance architectures, both legal and institutional, are fragmenting (International Law Commission, 2006; R. Jakhu & Pelton, 2017b; Ruggie, 2014). There are also space-specific causes of the stagnation of space law.

UN-COPUOS has long lost its rulemaking capability, for several reasons. It has become one of the largest UN committees, with nearly 90 members. The procedure in UN-COPUOS is

such that decisions are made by consensus, which provides them wide acceptance but also stalls or even prevents decision-making (Lyall & Larsen, 2009). Furthermore, some states strategically refrain from binding multilateral regimes. The committee is also fraught with disputes, notably along the North-South lines on the distribution of the benefits from space exploration. The combination of substantive division, a large committee, and a procedure of consensus, results in decades-long gridlock. As the Chair of UN-COPUOS noted, "the rules that have been codified in the series of treaties signed and ratified almost 60 years ago… are showing their age" (Kendall, 2017). Yet, UN-COPUOS no longer develops space law and governance (Brisibe, 2016; Galloway, 1979; Rajagopalan, 2018) and even the most pressing challenges - space debris, weaponization of space and mining space resources - are left un-answered. The Montreal Declaration, adopted at the end of a conference dedicated to space governance, noted that "the current global space governance system that was created during the 1960s and 1970s has not been comprehensively examined since…[although] numerous developments have [since] occurred … with serious implications for current and future space activities and for the sustainable use of space … [T]he time has come to assess the efficacy of the current regime of global space governance and to propose an appropriate global space governance system that addresses current and emerging concerns" (*Montreal Declaration*, 2014; R. Jakhu & Pelton, 2017a). Space governance is in a crisis (Tepper, 2017), there is a clear need for change but no emerging consensus on how to accomplish it (Schrogl, 2014).

3.3 Towards decentralized space governance

In many issue-areas in global affairs, including in outer space affairs, it is no longer feasible to negotiate a comprehensive and legally binding treaty. Alternatives include a 'building blocks' approach of negotiating partial arrangements that together may, gradually and incrementally, cover a substantial part of the issue-area (Falkner, Stephan, & Vogler, 2010; Ruggie, 2014). Indeed, some issue-areas already exhibit multiple and partly overlapping legal instruments and fora, what international relations scholars call 'regime complexes' (Raustiala & Victor, 2004; R. O. Keohane & Victor, 2011; Nye, 2014) and international law scholars call 'fragmentation' (International Law Commission, 2006). These are various versions or conceptualizations of decentralized governance, another one being polycentric governance. "Polycentric systems are characterized by multiple governing authorities at differing scales rather than a monocentric unit" (E. Ostrom, 2010b; E. Ostrom, 2010a; V. Ostrom, Tiebout, & Warren, 1961). Decentralized governance features multiplicity of decision-making centers'

(‘governance centers’) and legal instruments in a single issue-area. It is the inevitable future of space governance and the only way forward from the crisis in space governance.

Space governance is already on track to become decentralized. It started as a fairly centralized system, with a single forum – UN-COPUOS – introducing a set of comprehensive and legally binding treaties. However, in the many years since the last space law treaty, space governance started to decentralize. As demonstrated herein below, various sub-issue-areas have separate governance centers and legal instruments of different types and level of coherence, comprehensiveness, and legal force.

The allocation of slots in orbit around Earth and of radio frequencies that are used, inter alia, to command satellites and use them for communication, is regulated by a multilateral, legally binding, comprehensive and elaborate regime in accordance with the Constitution and Convention of the International Telecommunication Union (ITU) (ITU Constitution and Convention, 1992) and the ITU regulations. Practically all states are party to this regime, which is the best regulated sub-issue-area of space activities.

The issue of military uses of outer space has multiple, partial and scattered regulations and fora. The OST prohibits the placement of weapons of mass destruction in orbit around Earth and the establishment of military bases on celestial bodies. The 1963 Partial Test Ban Treaty (PTBT) bans nuclear weapons test in outer space. Many of the ‘laws of war’, part of public international law, are applicable to military uses of outer space. Relevant fora include, in addition to UN-COPUOS, the UN Security Council, and the Conference on Disarmament (CD). Yet, "[t]he principles of space law and current proposals to address the challenges of space security do not currently provide an effective normative framework to address the initiation and possible conduct of hostilities" (R. Jakhu & Pelton, 2017a, p. 298). The MILAMOS is an international study working to identify all the rules of international law applicable to military uses of outer space and organize them in a single manual (“MILAMOS,” n.d.). It will not introduce new rules but rather identify existing rules in various treaties and other legal instruments.

The issue of space debris is governed by non-legally binding ‘guidelines’ (Space Debris Mitigation Guidelines, 2007) and an inter-governmental forum Inter-Agency Space Debris Coordination Committee. However, as noted before, the quantity of space debris has sky-rocketed after the adoption of the guidelines, rendering the record of effectiveness of this voluntary regime quite dubious.

Another issue that has gathered significant attention – from the industry, scholars, and governments – is the extraction and utilization of space resources, e.g. titanium and other precious minerals on near-Earth asteroids, and water or helium3 on the Moon. The OST is vague about such operations and even the right to mine is contested (R. Jakhu, Pelton, & Nyampong, 2016; De Man, 2016). Instead, states are going at it alone. The US Act of 2015 recognizing the right to mine and also private ownership over extracted space resources (U.S. Commercial Space Launch Competitiveness Act, 2015) was already followed by Luxembourg in a law it adopted in 2017 (The Grand Duchy of Luxembourg, 2017). The UAE intends to do the same and other states wishing to engage in space mining will have the incentive to follow through. The combined result is that the governance of the utilization of space resources, clearly in the global level, evolves by States' unilateral acts, almost skipping the multilateral level. An independent research group that include members from the academe, government, and industry, is working on voluntary "Building Blocks for the Development of an International Framework on Space Resource Activities" (UN-COPUOS, 2018).

The issue of space traffic control, i.e. preventing collisions between space crafts and between a spacecraft and space debris, is another issue of growing importance (Eves, 2017). The apparent need for space traffic control was demonstrated by two recent collisions. In 2009, a commercial US satellite Iridium 33 collided with the Russian deactivated Kosmos-2251 satellite (Weeden, 2010). In 2013, Ecuador's first satellite, NEE-01 Pegaso, collided with space debris, was severely damaged and became defunct (Nader & Kelso, 2014). Currently, it is the US that manages a space situational awareness (SSA) system that tracks all objects larger than a softball and alerts all actors in space for possible collisions. There is still no agreement if space traffic control will be joined to existing mechanisms of air traffic control or will be independent but the issue of space traffic control in undergoing fundamental transformations. In June 2018 the US President signed Space Policy Directive-3 adopting a National Space Traffic Management Policy ("National STM Policy," 2018) the responsibility for the SSA system recently transferred from the DoD to the to the US the Department of Commerce, and the European Space Agency (ESA) is working on its own SSA system. Furthermore, in view of the upcoming civil space flights, there are also discussions whether to include space traffic control under the mandate of the International Civil Aviation Organization (ICAO), which has already started working on the subject ("ICAO Space Programme," n.d.).

As this review demonstrates, space governance is no longer developed by a single forum introducing comprehensive, multilateral and legally binding treaties. Instead, it is developing by various forums, including those established by various stakeholders, introducing different types of instruments, with partial coverage and varying legal authority. As partial and scattered as they are, they update and spread the coverage of space governance, and with more efforts directed to developing governance in this way, we can expect greater success at filling the gaps in space governance.

In terms of policy recommendations, promoting space governance requires promoting decentralized governance, i.e. by facilitating and encouraging the evolution of separate governance centers on each sub-issue-area and the introduction of specialized regimes providing rules for sub- issue-areas. This means that the evolution of one for weaponization and militarization, another one for space debris, a separate one for utilization of space resources and yet another one for space traffic control. Moreover, there could be more than one regime on each issue, just as there are five international regimes on the issue of export controls (Federation of American Scientists (FAS), n.d.; Nikitin, Kerr, & Hildreth, 2012). By dividing space governance to sub-issue-areas and promoting the introduction of separate regimes for each one, there are greater chances for the evolution of regimes that, in the aggregate, will amount to a decentralized, yet developed and updated governance system.

A decentralized governance system preferably has overarching institutions and basic principles that, like a constitution, run along all the various governance centers and institutions. In the context of space activities, it is the 1967 Outer Space Treaty that can and should still be the basis for all separate issue-specific regimes. UN-OOSA can provide crucial support and coordination between the various governance centers, though partial overlap and conflicts may exist, as they do in regime complexes and wherever there is fragmentation. Nevertheless, like with regime complexes, the merits outweigh the disadvantages, as it is better to have up-to-date rules on an issue than outdated rules or none at all. Moreover, borrowing Nye words on regime complexes, I suggest that what decentralized governance systems "lack in coherence, they make up in flexibility and adaptability" which is "[p]articularly [important] in a domain with extremely volatile technological change" (Nye, 2014). Needless to say, flexibility and adaptability are important especially in the issue-area of space activities which periodically sees significant breakthroughs in technology and commercial models. UN-COPUOS, which already "is arguably… at a crossroad, looking for its *raison d'etre* in the new Millennium" (Brisibe, 2016), will need to adopt its functions, e.g.

by serving as an overarching institution and a forum for multilateral discussions on broad systemic principles that apply across the issue-specific regimes. The roles, procedure, and goals of UN-COPUOS, of course, deserve a separate thorough discussion. UN-OOSA already works and assists all actors in space governance and therefore serves in practice as coordinator, bringing the accumulated knowledge and practices to each new actor. This bottom-up evolution of a decentralized governance system is a kind of 'spontaneous order', the emergence of order as a result of the voluntary activities of individual actors with no single guiding hand (Hayek, 1945; Smith, 1776).

3.4 The future of space governance

Globalization and governance seem to work in opposite directions. On the one hand, the world is ever smaller and connected, with a continuous decrease in time, cost and ease of transportation and the explosion of free, instant and sophisticated communications. On the other hand, global governance, that is supposed to complement globalization with regulation, is recently in retreat. Yet, despite and alongside the retreat of multilateralism, global governance expands. Multilateral regimes are still present and when they are not, the void is filled by regime complexes and other versions of decentralized governance. Indeed, despite the basic constraint of anarchy in global politics, inter-state relations are not lawless. In ancient times and much more so today, they are in fact organized and regulated by elaborate rules and practices (Watson, 1992). The scope of the rules and their enforcement may not be sufficient, but the existence of a wide array of principles, rules, and enforcement mechanisms and practices cannot be denied, as the review hereinabove of various issue-specific regimes demonstrates.

Space governance is becoming increasingly decentralized and polycentric, with multiple regimes established by various, subject-specific forums with various membership. Significantly, and although space activities transcend national borders and seemingly render national solutions inadequate more than any other global issue, national legislation and action do have a key role in the evolution of space governance, as the case of mining space resources demonstrates. Space governance is also becoming eclectic with each ~~specific~~ sub-issue-area having a separate and different regime. And while some sub-issue-areas exhibit a well-developed and organized multilateral regime, others may exhibit a partial regime or a regime complex and others yet reliance on national legislation and action.

The major breakthrough will come when, way down the road, space colonies will be self-sufficient and adopt governance systems independent from Earth. It is likely that some space habitats will become fully independent from earth, have their own laws and governance systems and possibly be detached from the earth-based global society.

4 New frontiers of human habitation and global society

4.1 Space habitation

"[H]uman migration is so fundamental an element of our behavior that it needs to be considered in the study of every aspect of our experience" (Manning, 2012). Looking down the road, the exploration and use of space, initially to serve life on earth, will eventually also bring about the habitation of space. Humans have been constantly living in space since 2000, aboard the international space station (ISS), but full-scale space habitats are still ahead. Space habitation may start sometime in the next two decades or it may take longer, but the race – and there is one – to colonize space will likely end in a human colony in space in this century. Participants in this include national space agencies of the US, Russia, China, the UAE and the European Space Agency (ESA) with the EU supporting another project through its seventh framework program. There are international collaborations, mainly of the US with Russia and China with ESA. Prominent participants in this race are private companies, notably Lockheed Martin, SpaceX, Blue Origin, and Bigelow Aerospace. There are several concepts and technologies for space habitats, i.e. a habitat on a celestial body, a habitat module floating in space or a habitat module orbiting a celestial body, but a major obstacle is the costs. Indeed, one of the major goals and contributions of the commercial space industry is lowering the costs for existing operations. SpaceX has already reduced the cost of launch to low earth orbit (LEO) by a factor of 20(!) (Jones, 2018) and the race is on for further reduction of costs.

Space habitation will be the most important human spatial expansion since modern humans (Homo sapiens) spread from Africa to other continents anywhere between 50,000 and 130,000 years ago (López, van Dorp, & Hellenthal, 2016) and certainly since the European migration to America. Modern humans' migration from Africa is a major milestone in human history and it eventually resulted in modern humans' domination of the entire world (after the Neanderthals and Homo erectus went extinct). The migration from Africa was initially a minor event, as the number of migrants was anywhere from 1,000 to 50,000 people. For comparison, the Great Atlantic Migration saw some 37 million Europeans migrating to the US during the 19th and 20th centuries in what is the largest human migration in history.

Similarly, a sustainable migration of even a small group of humans which is self-sufficient in space may be the start of a momentous turn in human history.

Human migration to new territories has through history had a profound impact on human society – on those who emigrate and the societies they create, join or subordinate, and, potentially, on those left behind. One cannot deny the influence that the US long has on Europe and the other places from which migrants came to the US. Likewise, migration to Europe in recent decades exposed people in the originating societies to alternative lifestyles and conditions and may have contributed to social and political processes in the countries of origin. A self-sufficient and strong colony is expected to significantly effect on life on Earth in many ways, from a destination for immigration to trade and security alliances or conflicts.

We can expect the first to inhabit space habitats to be elite population – scientists, astronauts, wealthy people–from various nations on Earth. Despite such 'space societies' being based on elite migrants, we can expect deviant behavior to occur, as a Russian experiment demonstrated. The experiment included six Russian male astronauts, one Japanese male astronaut and one Canadian female astronaut living in a replica of the Mir space station. Habitants in this experiment committed crimes - notably battery, assault, attempted murder and sexual harassment of the female astronaut, and the Japanese astronaut left the experiment sooner than planned, for fear of further assault. Hermida (Hermida, 2006) suggests that none of the existing theories of criminology can explain such deviant behavior committed by carefully selected individuals and that we lack understanding of the nature and causes of criminality in outer space. He argues that we will need a new approach to criminal behavior in space. We will, therefore, need to study deviant behavior in space and how to address it. If indeed current theories of criminology cannot explain deviant behavior in space, we might also find that other aspects of socializing in space are different. This may lead to the study of criminology, sociology, and other social sciences as they are in space.

We can expect that sometimes in this century Homo sapiens will establish space colonies, become a multi-planetary species, and perhaps attempt to establish dominance in parts of space. It will take time, but once a human colony is established in space and becomes self-sufficient, it is only a matter of time until the inhabitants of such a colony decide not to continue to receive 'orders' from Earth and opt to take their destiny in their own hands. When this happens, 'space governance' will mean a totally different thing than it means today.

4.2 SETI and dangerous encounters

There is an ongoing effort to find extra-terrestrial intelligence (ETI). The search for extra-terrestrial intelligence (SETI) is the quest to find if we are alone in the universe by looking and listening, notably using telescopes, for signs of ETI. There is also active SETI, also known as messaging to extraterrestrial intelligence (METI), which involves sending signals into space with the intention that they will be picked up by ETI. Contemplation of the existence of ETI and how to search for them dates back to Nikola Tesla and even before, but comprehensive scientific discussion of SETI emerged in the 1960s (Shklovsky & Sagan, 1966) and search projects were launched soon thereafter. Theoretical physicist Stephen Hawking asserted that statistically, ETI should exist (Hickman, 2010).

The are several ongoing projects and institutes that search for ETI, notably the California-based SETI Institute, the Ohio State University SETI program, the Berkeley SETI Research Center. The Planetary Society, a US-based NGO has several SETI projects, some in collaboration with Harvard University. China's FAST, the world's largest radio telescope, has SETI as one of its science missions and the UK Space Agency just announced a search for Earth-like planets which may hold alien life (Knapton, 2019). NASA is currently resuming interest in SETI pursuant to expected congressional funding (Koren, 2018), years after its SETI program was canceled in 1993 following a decision of Congress (Garber, 1999). In 2015, Stephen Hawking and Yuri Milner launched another SETI project - Breakthrough Listen – with initial funds of US$ 100 million that soon became the largest and most comprehensive and intensive SETI project. The search for alien life has significantly advanced since its early years with breakthroughs in technologies, theories, and projects (Jayawardhana, 2013). Lamb discusses whether SETI is a genuine scientific research programme as well as the benefits and drawbacks from establishing communication with ETI (Lamb, 2001).

Encounter with ETI may be dangerous. A Nature editorial suggested that "the risk posed by active SETI is real. It is not obvious that all extraterrestrial civilizations will be benign — or that contact with even a benign one would not have serious repercussions for people here on Earth" ("Ambassador for Earth," 2006). Hawking himself warned from the possibility that an ETI more advanced than us will treat us the way some societies on Earth treated less technologically-advanced societies they encountered (Hawking, 1998; Hickman, 2010). Others, however, dismiss these concerns (Finney, 1990).

If we ever detect - or be detected by – an ETI, then even if it proves peaceful, the mere detection may have a profound impact on global society. Discovery of ETI is expected to have social as well as scientific consequences (Dominik & Zarnecki, 2011). We can expect a range of human reaction, from joy to fear to chaos (Harrison, 2011). Such detection may lead to further scientific discoveries, but we may need to reconsider numerous conceptions across the social sciences and the humanities. There will surely be philosophical implications (Davies, 1996), yet Peters suggests that none of Earth's major religious traditions will collapse or even confront a crisis as a result of the discovery of ETI (Peters, 2011). Recent empirical studies assessing psychological reactions to the discovery of extraterrestrial life suggest that they are likely to be fairly positive (Kwon, Bercovici, Cunningham, & Varnum, 2018).

There are also policy and legal considerations. There are some initial efforts to think ahead the first steps to be taken if and when ETI is discovered. The International Academy of Astronautics (IAA) has addressed the issue and published the *Declaration of Principles Concerning Activities Following the Detection of Extraterrestrial Intelligence*, focusing on when and how to break the news to people on earth (International Academy of Astronautics (IAA), 1996). The IAA also published the *Draft Declaration of Principles Concerning Sending Communications with Extraterrestrial Intelligence*, which addresses who will handle such communication in the name of Earth (International Academy of Astronautics (IAA), 1996). While these are not legally-binding instruments, the first Declaration has subsequently been endorsed by the International Institute of Space Law (IISL), the Committee on Space Research (COSPAR) of the International Council for Science (ICSU), the International Astronomical Union (IAU) and the International Union of Radio Science (URSI).

The space law treaties do not specifically reference SETI, but it seems that SETI activities are in conformity with these treaties (Kopal, 1990). Should we discover ETI, we will need, inter alia, to adjust our space law and space governance thinking (Kopal, 1990). There is also a proposal for a totally new body of law - metalaw - one that will apply to the relations between humans and ETI (Fasan, 1970; Haley, 1956; Sterns, 2004).

ETI may not exist, and even if it does, we may never discover it, let alone contact or encounter it. But as SETI continues and humans are on track to become a multi-planetary species, and considering the statistical odds of the existence of ETI, a detection of ETI is possible. Such detection of ETI is expected to impact our actions and, moreover, also on our

understanding of the universe, our place within it and various concepts from the social sciences and humanities.

5 Conclusion and looking forward

Space applications have transformed transportation and communication, serving as powerful drivers of globalization of no less importance than trade agreements and international institutions like GATT, WTO, IMF and the World Bank. Their combined effect is the legal, institutional and physical infrastructure of globalization. Globalization, with its cross-border interconnection, interdependence, and engagement, increases the need for supra-national regulation, i.e. global governance. However, power in international politics is increasingly diffused, multilateral arrangements are ever more difficult to establish and even maintain, and multilateralism, in general, is contested. Space governance suffers from these trends in addition to space-specific hurdles, notably UN-COPUOS being one of the largest UN committees, fraught with disputes and working by consensus and practically paralyzed. The result is that the increase in the need for global governance in general and space governance, in particular, faces a decrease in capacity to introduce multilateral, comprehensive and legally binding regimes.

Since the dawn of the century, the commercial space sector has quickly expanded, and it has already taken the lead from national space agencies in what is known as "New Space". The new technological and commercial developments are pushing the boundaries of space law and putting a strain on the outed system of space governance. While the adoption of new space law treaties or the amendment of the old ones is, since the 1970s and for the foreseeable future, not feasible, space governance can evolve in several parallel different paths. Presently, the only way forward is by the evolution of separate, issue-specific governance centers and legal instruments (regimes), conforming to common basic principles, together incrementally building a decentralized space governance. These regimes, although partial and partly overlapping, will update and spread the coverage of space governance to a flexible decentralized system. All this happens and will happen in a kind of spontaneous order - as reviewed above, space governance is already on track to become decentralized, as various sub-issue-areas sees separate regimes with different degrees of elaboration, legal authority and effectiveness. The aggregate of all these regimes will be a more comprehensive and updated governance system than what a centralized system of global governance can yield.

Humankind is doing its first steps outside its cradle, Earth, and with already significant impact on global society and almost every aspect of our lives. We can expect that space exploration and utilization will further transform human life and global society, from one-hour cross-Atlantic sub-orbital flights to broadband internet everywhere in the near future to space habitation in the medium range and, potentially, to detection of extra-terrestrial intelligence.

References

==Ambassador for Earth. (2006). *Nature*, *443*, 606.

==Benvenisti, E., & Downs, G. W. (2007). The Empire's New Clothes: Political Economy and the Fragmentation of International Law. *Stanford Law Review*, *60*(2), 595–632.

==Bjola, C. (2017, October 14). Satellite Remote Sensing and Diplomatic Crisis Management. Retrieved February 14, 2019, from https://medium.com/digital-diplomacy/satellite-remote-sensing-and-diplomatic-crisis-management-286651c83cb.

==Bjola, C., & Holmes, M. (Eds.). (2015). *Digital Diplomacy: Theory and Practice* (1 edition). London ; New York: Routledge.

==Blake, D. (2014). Military Strategic Use of Outer Space. In H. Nasu & R. McLaughlin (Eds.), *New Technologies and the Law of Armed Conflict* (pp. 97–114). The Hague: T.M.C. Asser Press.

==Brisibe, T. (2016). Parliamentary Diplomacy in the United Nations and Progressive Development of Space Law. *European Journal of Law Reform*, *18*(1), 6–34.

==Davies, P. (1996). *Are We Alone?: Philosophical Implications Of The Discovery Of Extraterrestrial Life*. New York: Basic Books.

==Dawson, L. (2019). *War in Space: The Science and Technology Behind Our Next Theater of Conflict* (1st ed. 2018 edition). New York, NY: Springer.

==De Man, P. (2016). *Exclusive Use in an Inclusive Environment*. Cham: Springer International Publishing.

==Dominik, M., & Zarnecki, J. C. (2011). The Detection of Extra-Terrestrial Life and the Consequences for Science and Society. *Philosophical Transactions of the Royal Society*, *369*(1936), 499–507.

== The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences. (2009). Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance. Retrieved September 29, 2018 from https://www.nobelprize.org/prizes/economics/2009/advanced-information/.

==ESA. (2018, February 21). About Space Debris. Retrieved February 19, 2019, from http://www.esa.int/Our_Activities/Operations/Space_Debris/About_space_debris

==Eves, S. (2017). *Space Traffic Control*. Reston, Virginia: American Institute of Aeronautics and Astronautics.

==Falkner, R., Stephan, H., & Vogler, J. (2010). International Climate Policy after Copenhagen: Towards a 'Building Blocks' Approach. *Global Policy*, *1*(3), 252–262.

==Fasan, E. (1970). *Relations with Alien Intelligences: The Scientific Basis of Metalaw*. Berlin: Berlin Verlag.

==Federation of American Scientists (FAS). (n.d.). International Export Control Regimes. Retrieved March 15, 2019, from https://fas.org/nuke/control/export/regime.htm.

==Finney, B. (1990). The impact of contact. *Acta Astronautica*, *21*(2), 117–121.

==Forrester, C. (2018, February 22). SpaceX vs OneWeb; Battling to Connect the Planet. Retrieved January 25, 2019, from https://advanced-television.com/2018/02/22/inside-satellite-spacex-vs-oneweb-battling-to-connect-the-planet/

==Foust, J. (2018, January 2). 2018 May (Almost) Be the Year for Commercial Human Suborbital Spaceflight. *The Space Review*. Retrieved from http://www.thespacereview.com/article/3400/1

==Galloway, E. M. (1979). Consensus Decisionmaking by the United Nations Committee on the Peaceful Uses of Outer Space. *Journal of Space Law*, *7*(1), 11.

==Garber, S. J. (1999). Searching for Good Science: The Cancellation of NASA's SETI Program. *Journal of the British Interplanetary Society*, *52*, 3–12.

==General Data Protection Regulation (GDPR): Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC, Pub. L. No. Official Journal of the European Union 4.5.2016, L 119/1 (2016).

==Google Spain SL and Google Inc. v Agencia Española de Protección de Datos (AEPD) and Mario Costeja González, Case No. C-131/12 (Court of Justice of the European Union May 13, 2014). Retrieved February 27, 2019 from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A62012CJ0131.

==Governance, C. on G. (1995). *Our Global Neighbourhood: The Report of the Commission on Global Governance*. Oxford, New York: Oxford University Press.

==The Grand Duchy of Luxembourg. Law on the Exploration and Use of Space Resources, Official Gazette of the Grand Duchy of Luxembourg 674 § (2017). Retrieved January 21, 2019 from http://data.legilux.public.lu/file/eli-etat-leg-loi-2017-07-20-a674-jo-fr-pdf.pdf.

==Haley, A. G. (1956). *Space Law and Metalaw: A Synoptic View*. Associazione Italiana Razzi.

==Harrison, A. A. (2011). Fear, Pandemonium, Equanimity and Delight: Human Responses to Extra-Terrestrial Life. *Philosophical Transactions of the Royal Society*, *369*(1936), 656–668

==Hawking, S. (1998). *A brief history of time* (Updated and expanded tenth anniversary ed). New York: Bantam Books.

==Hayek, F. A. (1945). The Use of Knowledge in Society. The American Economic Review, 35(4), 519–530.

==Hermida, J. (2006). Crimes in Space: A Legal and Criminological Approach to Criminal Acts in Outer Space. *Annals of Air and Space Law, XXXI.*

==Hickman, L. (2010, April 26). Stephen Hawking Takes a Hard Line on Aliens. The Guardian. Retrieved January 25, 2019 from https://www.theguardian.com/commentisfree/2010/apr/26/stephen-hawking-issues-warning-on-aliens.

==Hofmann-Wellenhof, B., Lichtenegger, H., & Wasle, E. (2007). *GNSS – Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and more*. Springer Science & Business Media.

==ICAO Space Programme. (n.d.). Retrieved February 18, 2019, from https://www.icao.int/airnavigation/AeroSPACE-Transport/Pages/default.aspx

==International Academy of Astronautics (IAA). (1996). A Decision Process for Examining the Possibility of Sending Communications to Extraterrestrial Civilizations: A Proposal. Retrieved January 25, 2019 from https://iaaweb.org/iaa/Studies/seti.pdf.

==International Law Commission. (2006). *Report of the Study Group, Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law (A/CN.4/L.682)*. New York.

==ITU Constitution and Convention, 1992: Constitution and Convention of the International Telecommunication Union, 1825, 1826 UNTS § (1992)

==Jakhu, R., & Pelton, J. N. (Eds.). (2017). *Global Space Governance: An International Study*. Springer.

==Jakhu, R. S., & Pelton, J. N. (2013). *Small Satellites and Their Regulation*. Springer Science & Business Media.

==Jakhu, R., Pelton, J. N., & Nyampong, Y. O. M. (2016). Space Mining and Its Regulation. Springer.

==Jayawardhana, R. (2013). *Strange New Worlds: The Search for Alien Planets and Life Beyond Our Solar System*. Princeton University Press.

==Jones, H. W. (2018). The Recent Large Reduction in Space Launch Cost. Presented at the 48th International Conference on Environmental Systems, Albuquerque, New Mexico.

==Kane, V. (2013, October 23). The Potential of CubeSats. Retrieved January 25, 2019, from http://www.planetary.org/blogs/guest-blogs/van-kane/20131023-the-potential-of-cubesats.html.

=Kendall, D. (2017). Second Foreword. In R. S. Jakhu & J. N. Pelton (Eds.), *Global Space Governance: An International Study* (p. xi). Springer International Publishing.

==Keohane, R. O., & Victor, D. G. (2011). The Regime Complex for Climate Change. *Perspectives on Politics*, *9*(1), 7–23.

==Klein, J. J. (2012). *Space Warfare: Strategy, Principles and Policy*. Routledge.

==Knapton, S. (2019, March 8). Hunt for Alien Life Given £25m Boost by Government. The Telegraph. Retrieved from https://www.telegraph.co.uk/news/2019/03/08/hunt-alien-life-given-25m-boost-government/

==Kopal, V. (1990). International law implications of the detection of extraterrestrial intelligent signals. *Acta Astronautica*, *21*(2), 123–126.

==Koren, M. (2018, May 9). Congress Is Quietly Nudging NASA to Look for Aliens. Retrieved January 25, 2019, from https://www.theatlantic.com/science/archive/2018/05/seti-technosignatures-nasa-jill-tarter/558512/.

==Kwon, J. Y., Bercovici, H. L., Cunningham, K., & Varnum, M. E. W. (2018). How Will We React to the Discovery of Extraterrestrial Life? *Frontiers in Psychology*, *8*, 2308–2308.

==Lamb, D. (2001). *The Search for Extraterrestrial Intelligence: A philosophical Inquiry*. London ; New York: Routledge.

==Lechner, S. (2017a). Anarchy in International Relations (Vol. 1). Oxford University Press. https://doi.org/10.1093/acrefore/9780190846626.013.79, retrieved January 25, 2019

==Lechner, S. (2017b). Why Anarchy Still Matters for International Relations: On Theories and Things. *Journal of International Political Theory*, *13*(3), 341–359.

==Liability Convention, 1972: Convention on International Liability for Damage Caused by Space Objects, 961 UNTS 187 § (1972).

==López, S., van Dorp, L., & Hellenthal, G. (2016). Human Dispersal Out of Africa: A Lasting Debate. Evolutionary Bioinformatics Online, 11(Suppl 2), 57–68. https://doi.org/10.4137/EBO.S33489, retrieved January 22, 2019.

==Lyall, F., & Larsen, P. B. (2009). *Space Law, A Treatise*. Farnham, Surrey, England ; Burlington, VT: Ashgate.

==Manning, P. (2012). *Migration in World History* (2 edition). London ; New York: Routledge.

==MILAMOS: Manual on International Law Applicable to Military Uses of Outer Space. (n.d.). Retrieved February 19, 2019, from https://www.mcgill.ca/milamos/.

==Milner, H. (1991). The Assumption of Anarchy in International Relations Theory: A Critique. *Review of International Studies*, *17*(1), 67–85.

==Montreal Declaration, adopted at the 2nd Manfred Lachs International Conference on Global Space Governance, held in Montreal. (2014). Retrieved February 17, 2019 from https://www.mcgill.ca/iasl/files/iasl/montreal-declaration-2nd-manfred-lachs-conference.pdf.

==Moon Agreement, 1979: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, 1363 UNTS 3 § (1979).

==Morse & Keohane, 2014: Morse, J. C., & Keohane, R. O. (2014). Contested multilateralism. International Organizations, 94(4), 385–412.

==Nader, R., & Kelso, T. S. (2014). The Pegasus Incident: The Loss of the First Ecuadorian Satellite and its Recovery. In *Our world needs space: 65th International Astronautical Congress 2014 (IAC 2014) ; Toronto, Canada, 29 September - 3 October 2014* (Vol. 1). Toronto: Curran.

==NASA. (2017). CubeSat 101: Basic Concepts and Processes for First-Time CubeSat Developers. NASA. Retrieved January 25, 2019 from https://www.nasa.gov/sites/default/files/atoms/files/nasa_csli_cubesat_101_508.pdf.

== National STM Policy: Space Policy Directive-3, National Space Traffic Management Policy. (2018, June 18). Retrieved February 18, 2019, from https://www.whitehouse.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

==Nye, J. S. (2014). The Regime Complex for Managing Global Cyber Activities (Global Commission on Internet Governance Paper Series, 1). Centre for International Governance Innovation. Retrieved February 27, 2019 from https://www.cigionline.org/sites/default/files/gcig_paper_no1.pdf.

==Ostrom, E. (2010a). Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *The American Economic Review*, *100*(3), 641–672.

==Ostrom, E. (2010b). Polycentric Systems for Coping with Collective Action and Global Environmental Change. Global Environmental Change, 20(4), 550–557. https://doi.org/10.1016/j.gloenvcha.2010.07.004

==Ostrom, V., Tiebout, C. M., & Warren, R. (1961). The Organization of Government in Metropolitan Areas: A Theoretical Inquiry. *The American Political Science Review*, *55*(4), 831–842.

== Outer Space Treaty: Treaty on the Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, 18 UST 2410; 610 UNTS 205; 6 ILM 386 § (1967).

==Pang, A. S.-K., & Twiggs, B. (2011). Citizen Satellites. *Scientific American*, *304*(2), 48–53.

==Partial Test Ban Treaty: Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, 480 UNTS 43 § (1963).

==Pelton, J. N. (2012). *Satellite Communications*. New York: Springer-Verlag.

==Pelton, J. N., Madry, S., & Camacho-Lara, S. (Eds.). (2017). *Handbook of Satellite Applications* (Second Edition). Cham: Springer.

==Peters, T. (2011). The Implications of the Discovery of Extra-Terrestrial Life for Religion. *Philosophical Transactions of the Royal Society*, *369*(1936), 644–655.

==Rajagopalan, R. P. (2018). Space Governance. Oxford Research Encyclopedia of Planetary Science. https://doi.org/10.1093/acrefore/9780190647926.013.107, retrieved February 17, 2019

==Raustiala, K., & Victor, D. G. (2004). The Regime Complex for Plant Genetic Resources. *International Organization*, *58*(2), 277–309.

==Registration Convention: Convention on Registration of Objects Launched into Outer Space, 1023 UNTS 15 § (1974).

==Rescue Agreement: Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 672 UNTS 119 § (1968).

==Rosenau, J. N. (1995). Governance in the Twenty-first Century. *Global Governance*, *1*(1), 13–43.

==Ruggie, J. G. (2014). Global Governance and "New Governance Theory": Lessons from Business and Human Rights. *Global Governance*, *20*(1), 5–17.

==Schrogl, K.-U. (2014). The new debate on the working methods of the UNCOPUOS Legal Subcommittee. *Acta Astronautica*, *105*(1), 101–108.

==Selva, D., & Krejci, D. (2012). A survey and assessment of the capabilities of Cubesats for Earth observation. *Acta Astronautica*, *74*, 50–68.

==Sheetz, M. (2019, March 18). Super fast travel using outer space could be $20 billion market, disrupting airlines, UBS predicts. CNBC. Retrieved from https://www.cnbc.com/2019/03/18/ubs-space-travel-and-space-tourism-a-23-billion-business-in-a-decade.html

==Shklovsky, I. S., & Sagan, C. (1966). Intelligent Life in the Universe. San Francisco: Holden-Day.

==Space Debris Mitigation Guidelines of the United Nations Committee on the Peaceful Uses of Outer Space, A/62/200, paras. 118 and 119 § (2007).

==Space Policy Directive-3, National Space Traffic Management Policy. (2018, June 18). Retrieved February 18, 2019, from https://www.whitehouse.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/

==Smith, A. (1776). An Inquiry into the Nature and Causes of the Wealth of Nations. London: W. Strahan and T. Cadell.

==Sterns, P. M. (2004). Metalaw and Relations with Intelligent Beings Revisited. *Space Policy*, *20*(2), 123–130.

==Tepper, E. (2017). Global Space Governance: The Crisis and the Search for Innovative Governance Models. In E. Dynia & L. Brodowski (Eds.), *Aviation and Space Law and Technology*. Poland: Rzeszów University Publishing.

Tepper, E. (2018). Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons. Space Policy. https://doi.org/10.1016/j.spacepol.2018.06.004, retrieved January 21, 2019.

==UN Committee on the Peaceful Uses of Outer Space, 2018): UN Committee on the Peaceful Uses of Outer Space. (2018). Status of International Agreements relating to Activities in Outer Space as at 1 January 2018 (No. A/AC.105/C.2/2018/CRP.3).

==UN-COPUOS. (2018). *The Hague Space Resources Governance Working Group: Information Provided by the Netherlands (U.N. Doc. A/AC.105/C.2/2018/CRP.18)*.

==United Nations Development Programme (UNDP). (1999). *Human Development Report*. Oxford University Press.

==U.S. Commercial Space Launch Competitiveness Act, Pub. L. No. 114–90, 129 STAT. 704 (2015). Retrieved January 25, 2019 from https://www.congress.gov/114/plaws/publ90/PLAW-114publ90.pdf.

==Watson, A. (1992). The Evolution of International Society: A Comparative Historical Analysis. Routledge.

==Weeden, B. (2010). *2009 Iridium-Cosmos Collision Fact Sheet*. Retrieved February 24 from https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf.

===Weiss, T. G., & Thakur, R. (2010). *Global Governance and the UN: An Unfinished Journey*. Bloomington: Indiana University Press.

==Wolfe, A. W. (1979). Emergence of Global Society: Introduction. Presented at the 78th Annual Meeting of the American Anthropological Association, Cincinnati, Ohio. Retrieved January 21, 2019 from http://scholarcommons.usf.edu/ant_facpub/17?utm_source=scholarcommons.usf.edu%2Fant_facpub%2F17&utm_medium=PDF&utm_campaign=PDFCoverPages.

== Zürn, M. (2013). Globalization and Global Governance. In W. Calsnaes, T. Risse, & B. A. Simmons (Eds.), *Handbook of International Relations* (pp. 401–425). London: SAGE Publications Ltd. https://doi.org/10.4135/9781446247587