

**POLYCENTRIC MULTILATERALISM:
REIMAGINING THE ROLES OF INTERNATIONAL
INSTITUTIONS IN SPACE GOVERNANCE AND BEYOND**

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ABSTRACT

Using the case study of space governance, this paper envisions a polycentric approach to the governance of critical transnational challenges. Reimagining the roles of long-standing multilateral international institutions that suffer from decades-long gridlock, this study explores the capacity of polycentricity to provide efficient responses to the governance of the global commons and global affairs more generally. Nobel Laureate Elinor Ostrom (Economic Sciences, 2009) found strong empirical proof favoring polycentric governance of local commons, and suggested the conclusions not empirically tested for global commons, leaving, as Keohane observed, “unexploited opportunities” for investigators seeking to understand issues in global affairs. The research presented in this paper builds on the theoretical and empirical strength of the Ostrom Workshop at Indiana University, Bloomington, where it was conducted. It explores the validity of Elinor Ostrom’s design principle to space governance using the methods employed at the Social-ecological systems meta-analysis database (SESMAD) project. The paper tests the hypothesis that Ostrom’s findings can be sustained to global commons or global affairs more generally. Based on the research finding, this paper seeks to reimagine the role of existing international institutions as less of monocentric decision-making centers and more as connecting hubs that support and coordinate emerging polycentric networks. We call it ‘polycentric multilateralism’. This approach would reinvigorate the existing institutional system to better respond to contemporary and future challenges (e.g., space debris, space security, space resource exploitation). A polycentric structure would be better adapted to the reality of global politics, including of power shifts and power diffusion.

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I. INTRODUCTION

Near-earth space has long been a domain of scientific progress as well as geopolitical conflict, but is increasingly also an arena of economic activity. A case in point is the rise of StarLink constellations, which number more than 4,500 as of this writing and are already providing satellite-based broadband Internet access to more than 1.5 million paying subscribers.¹ SpaceX plans to

¹ See Jon Brodtkin, SpaceX projected 20 million Starlink users by 2022—it ended up with 1 million, Ars Technica (Sept. 13, 2023), <https://arstechnica.com/tech-policy/2023/09/spacex->

eventually have more than 40,000 satellites in orbit.² Other companies, and nations, are seeking to follow the example set by SpaceX and launch their own competing mega constellations. This will make the final near-Earth frontier increasingly crowded, highlighting governance gaps in space law that have long been apparent but now threaten its sustainable and peaceful development.

This Article applies insights from the Ostrom Workshop tradition to issues in the space commons, including empirical analysis of global commons governance applied to space, and concepts and frameworks including polycentricity and the Ostrom Design Principles. We seek to ascertain to what extent these tools, which were developed to study local governance systems and collective action challenges, are applicable to global issues like space, and how they may provide a bridge to the type of concerted multilateral action that has been largely absent in space governance since the failure of the Moon Treaty in the late 1970s - early 1980s.³

II. THE STRUGGLE TO GOVERN THE (SPACE) COMMONS

A. *The Ancient Problem of Collective Action*

The problem of collective action is as old as human gathering, and scholarship on the problem dates all the way back to ancient Greece. When people work together - or need to work together - to achieve a common objective, the collective action problem arises. It manifests itself in two specific problems that, although separate and different in nature, are often confused to be essentially the same: (i) free-riding and (ii) the tragedy of the commons. The first refers to actors who evade contributing to a group good which they enjoy,⁴ while the second refers to actors over-consuming a shared

[projected-20-million-starlink-users-by-2022-it-ended-up-with-1-million/#:~:text=Starlink%20now%20has%20%22well%20over,to%20a%20CNBC%20article%20today.](#)

² Tereza Pultarova, Elizabeth Howell, Starlink satellites: Everything you need to know about the controversial internet megaconstellation, Space.com (Aug. 2, 2023), <https://www.space.com/spacex-starlink-satellites.html>.

³ See Scott J. Shackelford, *Governing New Frontiers in the Information Age: Toward Cyber Peace* (Cambridge 2020), chapter 5: *Governing the Final Frontier: A Polycentric Approach for Managing Space Weaponization and Debris*; and Eytan Tepper, [The Big Bang of Space Governance: Towards Polycentric Governance of Space Activities](#), 54 N.Y.U. J. Int'l L. & Pol. 485 (2022).

⁴ On the free rider problem see MANCUR OLSON, *THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS* (1965).

resource, leading to its depletion.⁵

The problem of collective action was popularized by the American political economist Mancur Olson in his book, *The Logic of Collective Action*. But scholarship on the problem, not necessarily using this terminology, has a long history, and it has occupied the minds and works of the most prominent political philosophers. Consideration of collective action dates back at least to the late 5th century B.C.E, when Thucydides wrote: ⁶

“[T]hey devote a very small fraction of the time to the consideration of any public object, most of it to the prosecution of their own objects. Meanwhile, each fancies that no harm will come to his neglect, that it is the business of somebody else to look after this or that for him; and so, by the same notion being entertained by all separately, the common cause imperceptibly decays.”

A few centuries later, Plato and Aristotle also touched upon issues of collective action. In Plato’s *Republic*, the character Glaucon sees logic in his argument against obedience to the law if only one can escape sanction for violations.⁷ Aristotle said, “That which is common to the greatest number gets the least amount of care. Men pay most attention to what is their own: they care less for what is common.”⁸

While these works hinted at ideas of collective action, Thomas Hobbes stated the idea clearly, writing in *Leviathan* (1651), “if any two men desire the same thing, which nevertheless they cannot both enjoy, they become enemies.”⁹ Hobbes, having been influenced by Machiavelli, believed that

⁵ On the tragedy of the commons see Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243–48 (1968). While the free rider problem is generally relevant to ‘public goods’, the tragedy of the commons is generally relevant to common-pool resources – in both cases it is difficult, legally or practically, to exclude actors from using the good or resource (think of clean air or security), and the difference is that public goods have no rivalry (one’s enjoyment from security does not derogate from her neighbor’s ability to enjoy security), while common-pool resources have rivalry (think of a fishing stock or pasture) (for the definition and distinction of the various types of goods or resources, see Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 THE AMERICAN ECONOMIC REVIEW 641–672 (2010)).

⁶ Thucydides, *The History of the Peloponnesian War*, Bk. I, Sec. 141 (<https://mises.org/es/library/mises-and-thucydides>)

⁷ Plato, *Republic*, bk. 2, 360 B.C.

<https://plato.stanford.edu/entries/free-rider/#His>

⁸ Aristotle, *Politics*, Book II, Chapter 3

https://www.garretthardinsociety.org/articles/art_ecolate_view_human_predicament.html

⁹ Hobbes, Thomas, [1651] 1996, *Leviathan, or the Matter, Forme, and Power of a*

people's nature caused them to act out of self-interest. He proposed that people would naturally harm others if it would produce a personal benefit, rendering it necessary to have a powerful state to regulate behavior, thus enabling investment and exchange. Some scholars view this as an early conception of both the prisoner's dilemma and the free rider problem.¹⁰

In *A Treatise of Human Nature* (1739), David Hume provided an early and better-known interpretation of what is now called the collective action problem:¹¹

Two neighbors may agree to drain a meadow, which they possess in common; because it is easy for them to know each other's mind; and each must perceive that the immediate consequence of his failing in his part, is, the abandoning the whole project. But it is very difficult, and indeed impossible, that a thousand persons should agree in any such action; it being difficult for them to concert so complicated a design, and still more difficult for them to execute it; while each seeks a pretext to free himself of the trouble and expense, and would lay the whole burden on others.

Thereafter, Jean-Jacques Rousseau conceived of the stag hunt game in his publication *A Discourse on Inequality* (1755). He wrote, “[i]f it was a matter of hunting a deer, everyone well realized that he must remain faithful to his post; but if a hare happened to pass within reach of one of them, we cannot doubt that he would have gone off in pursuit of it without scruple...”¹² This story is a prototype of Rousseau's social contract theory, but it also influenced Hume's conception of collective action. In *An Enquiry Concerning the Principles of Morals* (1751), Hume created a new version of the stag game, writing, “[t]wo men who pull at the oars of a boat, do it by an agreement or convention, tho' they have never given promises to each other...”¹³ ¹⁴ Adam Smith's (1776) argument for the invisible hand that keeps sellers competitive rather than in collusion is an instance of the logic of collective action. He says that each producer “intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the

Commonwealth Ecclesiastical and Civil Cambridge: Cambridge University Press.
<https://plato.stanford.edu/entries/free-rider/#His>

¹⁰ <https://plato.stanford.edu/entries/free-rider/#His>

¹¹ *A Treatise of Human Nature* (1739)

¹² Jean-Jacques Rousseau, *A Discourse on Inequality* (1755)

¹³ David Hume, *Enquiry Concerning the Principles of Morals*, Appendix III, Paragraph

¹⁴ Brian Skyrms, *The Stag Hunt* (2001)

society that it was no part of [the individual's intended end]. By pursuing his own interest he frequently promotes that of society more effectually than when he really intends to promote it.”¹⁵

The scholarship of the collective action problem continued into the 19th century with the contribution of the British economist William Forester Lloyd. In his essay *Two Lectures on the Checks to Population* (1833), Lloyd employed a hypothetical example of the effects of unregulated grazing on common land, also known as “the commons” in Anglo-Saxon law.

Although other philosophers and social scientists carried on with this work, such as John Stuart Mills¹⁶ and Vilfredo Pareto¹⁷, the collective action problem did not truly take off until the American economist Mancur Olson published *The Logic of Collective Action* (1965).¹⁸ Olson theorized that coercion or some other device must be present in order for a group of individuals to act in their common interest, suggesting that collective action problems were solved in large groups by the use of selective incentives.¹⁹

Three years later, Garrett Hardin published *The Tragedy of the Commons* (1968), an essay on ecology, population theory, economics, and political science.²⁰ Hardin argues that human overpopulation will stress ecosystems beyond their limits and cause a resource catastrophe.²¹ This theory explains individuals' tendency to make decisions based on their personal needs, regardless of the negative impact it may have on others. The influence of this publication cannot be understated, as it is one of the most cited works in the social sciences.²²

Hardin's publication spurred numerous critiques. Many disavowed his work for being racist and amounting to the support of eugenics. “In his later years, Hardin's racism became more explicit. ‘My position is that this idea of a multiethnic society is a disaster,’ he told an interviewer in 1997. ‘A multiethnic society is insanity. I think we should restrict immigration for that reason.’ Hardin died in 2003, but the nonprofit Southern Poverty Law Center, alert to the longevity of his ideas, maintains his profile in its ‘extremist files’ and classifies him as a white nationalist.”²³

¹⁵ <https://plato.stanford.edu/entries/free-rider/#His>

¹⁶ [1848] 1965, book 5, chap. 11, sect. 12

¹⁷ Pareto 1935, vol. 3, sect. 1496, pp. 946–7

¹⁸ <https://plato.stanford.edu/entries/free-rider/#His>

¹⁹ <https://www.britannica.com/topic/collective-action-problem-1917157>

²⁰ *The Tragedy of the Commons* (1968)

²¹ <https://online.hbs.edu/blog/post/tragedy-of-the-commons-impact-on-sustainability-issues#:~:text=In%201968%2C%20the%20term%20%E2%80%9Ctragedy,it%20may%20have%20on%20others.>

²² <https://www.thelandmagazine.org.uk/articles/short-history-enclosure-britain>

²³ <https://aeon.co/essays/the-tragedy-of-the-commons-is-a-false-and-dangerous-myth>

Many other academics have critiqued the academic merits of his work. For example, Bryan Burke claims that Hardin's theories of the commons are based on rational choice assumptions that may not always reflect real conditions.²⁴ Megan McArdle writes that Hardin failed to distinguish between common property and open-access resources, which is important because the former does not succumb to the tragedy of the commons due to communal resource management.²⁵ McArdle also points out that Hardin "overlooked . . . [that] the political process often replicates the same economic dynamics that encourage the tragedy of the commons." *Id.* Of the critiques directed at Hardin, the most prominent are from Elinor Ostrom, whose research and writing on the subject earned her the 2009 Nobel prize in economics. Ostrom's theories on the problem of collective action and refutations of Hardin will be further elaborated on in **Section II-C**.

B. Collective Action Problems in Global Affairs

This section will review the global affairs equivalent of the collective action problem – international cooperation – as investigated mainly by international relations scholars as well as international law scholars.

The need to cooperate – and the problems associated with collective action – appear also in the relations between states. This problem dates back to the early encounters between independent political entities or societies. Sporadic inter-societies relations evolved over time. Buzan and Little trace the first appearance of an international system to 3,500 BCE with the interaction of ancient Sumerian city-states, representing the first fully-fledged international system.²⁶ In the context of global affairs, collective action may be referred to as international cooperation, and it is studied by international relations scholars, as well as international law scholars. Keohane suggests that international cooperation occurs "when actors adjust their behavior to the actual or anticipated preferences of others, through a process of policy coordination."²⁷ If collective action of people often

²⁴ <https://www.jstor.org/stable/4603411>

²⁵ <https://www.theatlantic.com/business/archive/2012/05/property-rights-and-the-tragedy-of-the-commons/257549/>

²⁶ Barry Buzan and Richard Little, *International Systems in World History: Remaking the Study of International Relations* (Oxford 2000). For the history of International Relations as a discipline see, for example, Michael C. Williams, *In the Beginning: The International Relations Enlightenment and the Ends of International Relations Theory*, 19(3) *European Journal of International Relations* (2013), 647.

²⁷ Robert Keohane, *After Hegemony* (Princeton: Princeton University Press, 1984), 51-52. See also Charles Lindblom, *The Intelligence of Democracy* (New York: Free Press, 1965), 227.

conflicts with and hindered by their contradicting personal interest, collective action of states, or international cooperation, often conflicts and is hindered by contradicting interests of states.

In the context of international relations, cooperation is often institutionalized, taking place within and by international organizations. The study of international institutions is, therefore, a study of international cooperation, or the collective action problem in the context of global affairs.

Realism, the school that dominated early-mid 20th century international relations thought, places power in the center of its focus and may be seen as skeptic towards international cooperation. Realist scholars see power exerting the true influence behind the facade of institutional structures.²⁸ Mearsheimer even went so far as suggesting that “formal international organizations are ultimately dominated by the most powerful states, or are designed to be irrelevant to international affairs.”²⁹ Hans Morgenthau, perhaps the father of international relations, and certainly the father of realism, attributed behavior that was consistent with institutional rules as either “convergent interests or prevailing power relations, arguing that governments ‘are always anxious to shake off the restraining influence that international law might have upon their foreign policies, to use international law instead for the promotion of their national interests...’.”³⁰ In the last two decades of the 20th century, neorealists critiques of institutional analysis rose to prominence. Downs, Rocke, and Barsoom assert the “claim that deep cooperation – anything other than superficial policy adjustments about which – requires enforcement.”³¹ This basically denies the possibility of meaningful international cooperation, as enforcement is the opposite of cooperation: while cooperation is voluntary, stemming from various motives and incentives, enforcement is coercion.

Liberalism is the main rival school of international relations, and liberal scholars have a different view of international cooperation, suggesting that institutions, norms and interdependency contain and mitigate the violent power of states. The international order built after World War II fits this view, as it includes institutions and norms and economies that trade and are dependent on others.³² These provide benefits to those who cooperate and impose a cost on those who do not. In other words – they mitigate the collective action problem. Regime Theory, a strain of liberalism, seeks to explain the rise of complex interaction between states, organizations, corporations, and other institutions, in other words – collective action.

²⁸https://scholar.harvard.edu/files/bsimmons/files/ch_13_-_international_os_and_is.pdf

²⁹ Mearsheimer 1994–95.

³⁰ Morgenthau 1985.

³¹ Downs, Rocke, and Barsoom (1996).

³² On the liberal world order see Daniel Deudney and G. John Ikenberry (1990).

Regime theorists suggest that international cooperation is possible even in anarchic system, devoid of a global supreme authority, and that international institutions and regimes facilitate such cooperation and are themselves instances of such cooperation.

International cooperation takes place also beyond formal international institutions, in a plethora of forums, agreements, and arrangements of various types, by which actors cooperate, creating international 'regimes'. A Regime, according to Krasner's classic definition, is a set "of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations."³³ Keohane refutes the idea that international cooperation requires a hegemon, noting the international regimes, through which international cooperation takes place. He views international regimes not as weak substitutes for world government but as devices for facilitating decentralized cooperation among egoistic actors.³⁴

Keohane's and Krasner's work was informed by a fundamentally important insight: individual rational action by states could impede mutually beneficial cooperation. Institutions would be effective to the degree that they allowed states to avoid short-term temptations to renege, thus realizing available mutual benefits. In particular, institutions could help to focus expectations on a cooperative solution, reduce transaction costs, and provide a greater degree of transparency. Reputational concerns and the prospect of repeat interactions were supposed to render cooperative rules effective. Recent applications of this basic functionalist logic have been applied in issues ranging from the settlement of territorial disputes³⁵ to international cooperation with respect to freshwater resources.³⁶

The struggle to achieve international cooperation, and the academic discourse on its feasibility, is the starting point of this study, which explores the potential contribution of Ostrom's theory to understanding and facilitating international cooperation.

C. Polycentric Governance of Local Commons

The Bloomington School, as it became known, developed out of scholarly efforts on Public Choice theory in the field of economics.³⁷ The work of Vincent and Elinor Ostrom, which has spawned newer generations of

³³ See also Krasner, *supra* note 182, at 186.

³⁴ Robert Keohane, *After Hegemony* (Princeton: Princeton University Press, 1984).

³⁵ Simmons 2005.

³⁶ Dombrowsky 2007.

³⁷ William C. Mitchell, Virginia, Rochester, and Bloomington: Twenty-Five Years of Public Choice and Political Science, *Public Choice* 56(2), 112 (1988).

scholars, is praised by some scholars for its eclecticism, providing new ways to analyze institutional arrangements, initially at the local level.³⁸ Elinor and Vincent Ostrom's work initially focused on local actors, particularly public goods in polycentric systems. For instance, some of Elinor Ostrom's first experiments in what would become the Workshop in Political Theory and Policy Analysis examined police departments and public perceptions in the Indianapolis metropolitan area in the early 1970s.³⁹ Likewise, Vincent Ostrom and his colleagues seminal work that laid the foundation for the Ostroms' later research on the theoretical end was *The Organization of Government in Metropolitan Areas: A Theoretical Inquiry*, which examined "polycentric political systems" in metropolitan areas. It is with this foundation that the Ostroms began to challenge the traditional approaches to issues in the public choice field, notably with the regards to the collective action problem.

Garrett Hardin's *The Tragedy of the Commons* laid out the central governance issue presented by resources used and managed by multiple actors. Hardin presented the example of a pasture where many herdsmen graze their cattle. The herdsmen, acting in their own self-interest, are encouraged to graze as many cattle as they can. However, if each herdsmen increases their cattle to maximize their reward, the pasture is diminished, rendering the pasture barren and unusable by any herdsman. To solve this, Hardin offers only two solutions, privatization and government regulation. In this one of the most cited and influential manuscript in the social sciences, Hardin stated "Freedom in a commons brings ruin to all."

Ostrom criticized Hardin's model as being too simplistic and failing to account for real world use of local commons in practice. In a study that would award her the Nobel prize in economic sciences, Elinor Ostrom refuted Hardin's theory, both theoretically and, significantly, empirically. Ostrom and other researchers affiliated with the Workshop demonstrated the feasibility of collective action in local-level common-pool resources, and the superiority of polycentric governance to both the state and the market.⁴⁰ In

³⁸ Aurelian Craiutu, In Praise of Eclecticism: Why Elinor and Vincent Ostrom's Works Matter, in Herzberg et al., *Ostrom's Tensions: Reexamining the Political Economy and Public Policy of Elinor Ostrom* (Mercatus Center 2019).

³⁹ Elinor Ostrom, Ventures in Research and Teaching, A&S Review (Indiana University 1974); Elinor Ostrom, Multi-Mode Measures: From Potholes to Police, Public Productivity Review (1976).

⁴⁰ Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, 641 (2010), ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 2, 182–92 (1st ed. 1990); Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, 641 (2010), ELINOR OSTROM, GOVERNING

addition, Elinor Ostrom devised, based on the vast empirical database, eight design principles for robust governance systems, which are further elaborated below.

D. The Leap from Local to Global Commons and Global Affairs

Elinor Ostrom's Nobel-winning study (*Economic Sciences*, 2009) found strong empirical proof, in lab and in the field, across countries and sectors, favoring polycentric governance of *local* commons.⁴¹ However, it has not been empirically tested for *global* commons and the potential to apply Ostrom's theory to global affairs remains untapped, leaving, as Keohane observed, "unexploited opportunities" for investigators seeking to understand issues in global affairs.⁴² His call to further study this potential remained largely unanswered, until today.

The hypothesis of this study is that, indeed, the lessons learned regarding local commons, and in particular the eight design principles, also apply to global commons. Ostrom herself, together with Dietz and Stern, suggested that many of the general principles for robust governance systems for local resources "also appear to be applicable to regional and global resources, although they are less well tested at those scales."⁴³ The first leap is from local commons to global commons, and the section below applying the SESMAD methodology tests the validity of this leap. If proven, the second leap would be from global commons to global affairs.

The second leap is also imaginable. The Nobel committee noted, "[Ostrom's] observations are important not only to the study of natural resource management, but also to the study of human cooperation more generally."⁴⁴ If this is the case, they are relevant also to international

THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 2, 182–92 (1st ed. 1990).

⁴¹ Nobel committee report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance, (12 OCTOBER 2009) available online at http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html.

⁴² Robert O. Keohane, Review Symposium: Beyond the Tragedy of the Commons, 8(2) *Perspectives on Politics* (2010), 577. See also Robert O. Keohane and Elinor Ostrom (eds), *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (Sage 1995).

⁴³ Dietz, Thomas, Elinor Ostrom and Paul C. Stern, *The Struggle to Govern the Commons*, 302 (5652) *Science* (2003), 1907, 1910.

⁴⁴ Nobel committee report: The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, Scientific Background on the Sveriges Riksbank Prize in

cooperation, in other words – to global affairs and global governance. Indeed, Keohane suggested that Ostrom’s theory might apply to international relations and provide important insights. If both leaps are sustained, then polycentric governance would be a practical solution to the collective action problem of governing outer space and space activities and to international cooperation in general.

E. The Pushback Against Designating Space as Global Commons

There is an ongoing debate whether space is global commons. It is more than a pure scholastic debate; words are the initial bricks that help structure our reality. In the legal context, words have a world of implications. Before testing the applicability of Ostrom’s theory to space-as-global-commons, it is therefore of the essence to ask whether indeed space is global commons. But what is ‘global commons’? there is no authoritative or agreed-upon definition. The following is a review of several key definitions and their application to space.

The UN Division of Environmental Law and Conventions⁴⁵ and the OECD⁴⁶, as well as by scholars such as Buck⁴⁷, Vogler⁴⁸, and Schrijver⁴⁹, focus on a single feature – where no state can have jurisdiction or sovereignty. Buck adds a second characteristic - having free access to the domain – but this is derived from and similar to the former - a domain being beyond national jurisdictions. Under these definitions, space is global commons, as Article II of the widely accepted Outer Space Treaty provides that “ Outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.” Article I of the treaty also satisfies Buck’s additional

Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance, (12 OCTOBER 2009) available online at http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html.

⁴⁵ United Nations Environment Programme, Division of Environmental Law and Conventions, <http://www.unep.org/delc/GlobalCommons/tabid/54404/> (last visited January 4, 2016). The page has since been removed.

⁴⁶ Organization for Economic Co-operation and Development, Glossary of Statistical Terms, Global Commons, online at <https://stats.oecd.org/glossary/detail.asp?ID%41120> (last visited May 21, 2018).

⁴⁷ SUSAN J. BUCK, *THE GLOBAL COMMONS: AN INTRODUCTION* (2nd ed. edition ed. 1998).

⁴⁸ JOHN VOGLER, *THE GLOBAL COMMONS: ENVIRONMENTAL AND TECHNOLOGICAL GOVERNANCE* (2nd. ed. 2000), <http://www.wiley.com/WileyCDA/WileyTitle/productCd-047198826X.html> (last visited Jun 11, 2017).

⁴⁹ Nico Schrijver, *Managing the Global Commons: Common Good or Common Sink?*, 37 *THIRD WORLD QUARTERLY* 1252–1267 (2016).

criteria when it provides that “ Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States... and there shall be free access to all areas of celestial bodies...”. In her study of the global commons Buck specifically suggests that “Global commons are resource domains to which all nations have legal access, such as outer space”.⁵⁰ Indeed, there are three or four traditionally recognized global commons the high seas, outer space, and Antarctica, and some add the atmosphere.

Some scholars suggest that space is global commons. For example, Neto, focusing on this particular questions, concludes that “outer space constitutes a global commons as a matter of fact and law”.⁵¹ However, there has been a pushback against viewing space as global commons, particularly by the U.S. The Trump administration even clearly and formally stated that space is not global commons.⁵² the Biden administration did neither reiterate nor backtracked on this declaration, and the civil space policy it adopted in 2021 does not include the phrase ‘global commons’ at all,⁵³ so it would seem to continue to be official U.S. policy. It may be that this position is motivated by a concern that acknowledging space as global commons incurs property or governance ramifications, specifically that resource extraction and exploitation would require the agreement of all states, or an international organizations, and would also require the sharing of the revenues with other states.⁵⁴ Indeed, the formal U.S. declaration that space is not global commons

⁵⁰ SUSAN J. BUCK, *THE GLOBAL COMMONS: AN INTRODUCTION* (2nd ed. edition ed. 1998), p. 6.

⁵¹ de O. Bittencourt Neto, O. (2021). "Chapter 1: Outer space as a global commons and the role of space law". In *A Research Agenda for Space Policy*. Cheltenham, UK: Edward Elgar Publishing.

⁵² On December 11, 2017 President Trump adopted the Space Policy Directive–1, that provides: “Americans should have the right to engage in commercial exploration, recovery, and use of resources in outer space, consistent with applicable law. Outer space is a legally and physically unique domain of human activity, and *the United States does not view it as a global common*. Accordingly, it shall be the policy of the United States to encourage international support for the public and private recovery and use of resources in outer space, consistent with applicable law. <https://www.federalregister.gov/documents/2020/04/10/2020-07800/encouraging-international-support-for-the-recovery-and-use-of-space-resources>.

⁵³ <https://www.whitehouse.gov/wp-content/uploads/2021/12/United-States-Space-Priorities-Framework--December-1-2021.pdf>.

⁵⁴ On the various opinions of space as global commons see, for example, de O. Bittencourt Neto, O. (2021). "Chapter 1: Outer space as a global commons and the role of space law". In *A Research Agenda for Space Policy*. Cheltenham, UK: Edward Elgar Publishing ([link](#)); Secure World Foundation, *Space Sustainability Briefs*, *Is Space a*

Global Commons? ([link](#)); John S. Goehring , *Why Isn't Outer Space a Global Commons?* ([link](#)); Henry R. Hertzfeld et al *How Simple Terms Mislead Us: The Pitfalls of*

is part of the presidential executive order focusing on space resource exploitation and titled: “Encouraging International Support for the Recovery and Use of Space Resources.”⁵⁵

Tepper suggests that the notion of “global commons” does not imply the property rights regimes in the domains and resources it presumably describes, including outer space. Furthermore, Tepper suggests that a distinction should be made between economic and legal commons and that one needs to examine each and every part of space instead of labeling space as a whole. He summarizes his discussion asserting that “the real questions in the discourse are much more complex than “is space commons?”.”⁵⁶

The notion of ‘global commons’ also changes according to the context. In the context of strategic studies or defense strategy it has another meaning. The U.S. Department of Defense defines the global commons to comprise the geographic and virtual realms of “space, international waters and airspace, and cyberspace.”⁵⁷

For the purposes of this study, we view space as global commons in the narrow meaning of being beyond any and all national jurisdictions and in the sense that at least parts of space are common-pool resources. This meaning does not reflect the role of space in strategic studies or the right of states to exploit its resources without the need for prior agreement of all states or the sharing of the revenues with all states.

III. A POLYCENTRIC PATH FORWARD

A. *Polycentric governance and the 8 design principles for Robust Governance Systems*

Polanyi introduced the concept of ‘Polycentricism’⁵⁸ and Vincent Ostrom, Tiebout, and Warren introduced the concept of “polycentric governance.”⁵⁹ Vincent and Elinor Ostrom together with other scholars at the

Thinking about Outer Space as a Commons, (2015) ([link](#)); Brian Weeden & Tiffany Chow, Taking a common-pool resources approach to space sustainability: A framework and potential policies, 28 SPACE POLICY 3, 166-172 (2012).

⁵⁵ <https://www.federalregister.gov/documents/2020/04/10/2020-07800/encouraging-international-support-for-the-recovery-and-use-of-space-resources>.

⁵⁶ Eytan Tepper, Structuring the Discourse on the Exploitation of Space Resources: Between Economic and Legal Commons, 49 Space Policy 101290 (2019) ([link](#)).

⁵⁷ National Defense Strategy of the United States of America (Washington, DC: Office of the Secretary of Defense, 2008), 13. See also: Mark E. Redden and Michael P. Hughes, Defense Planning Paradigms and the Global Commons. <https://apps.dtic.mil/sti/pdfs/ADA536613.pdf>.

⁵⁸ MICHAEL POLANYI, THE LOGIC OF LIBERTY 138–42 (1951).

⁵⁹ See V. Ostrom, Tiebout & Warren, *supra* note 23, at 831 (using the concept of a polycentric political system to explain metropolitan governance).

Ostrom Workshop continued to develop the concept of polycentric governance.⁶⁰

A Monocentric system is a hierarchical system, with a single decision-making center, that enjoys a monopoly on power; a polycentric system, on the other hand, is decentralized, with multiple independent centers of decision-making, with at least partially overlap in jurisdictions⁶¹. One may assume that a polycentric system would be messy and excessive, but Elinor Ostrom asserted that “complexity is not the same as chaos”⁶² and demonstrated, theoretically and empirically, the case for polycentric governance of complex systems.⁶³ Furthermore, as noted before, she distilled, from the vast empirical database, eight design principles for robust governance systems: (1) Clearly defined boundaries; (2) Congruence between appropriation and provision rules and local conditions; (3) Collective-choice arrangements (users’ voting rights); (4) monitoring by the users of users and resources; (5) graduated Sanctions; (6) conflict-resolution mechanisms; (7) minimal recognition of rights to organize; and (8) nested enterprises. These will be elaborated below. While adhering to these principles does not guarantee successful governance, there is positive correlation between their appearance and a successful governance system. These key conditions may, to a certain extent, facilitate successful collective action.

Supported by robust theory and abundant empirical evidence,⁶⁴ these principles have become one of the most important and widely known and endorsed output in the CPR/commons literature. They may be regarded as ‘islands of stability’ in the abundance of variables that surrounds institutional analysis. Using these principles as measuring instruments, it becomes possible to structure the analytical process in different ways: determining their presence and understanding how they influence the process of managing CPRs, predicting the success of a governance system, analyzing sub-optimal institutions and estimating how appearance of the design principles may support the sustainability of a governance system. However, these principles

⁶⁰ See Paul D. Aligica & Vlad Tarko, *Polycentricity: From Polanyi to Ostrom, and Beyond*, 25 GOVERNANCE 237, 237–51 (2012).

1. ⁶¹ Vincent Ostrom, Polycentricity, in POLYCENTRICITY AND LOCAL PUBLIC ECONOMIES: READINGS FROM THE WORKSHOP IN POLITICAL THEORY AND POLICY ANALYSIS 52–74 (Michael D. McGinnis ed., 1999); Eytan Tepper, The Big Bang of Space Governance: Towards Polycentric Governance of Space Activities, 54(2) NYU J. Int’l L. & Pol. 485 (2022).

⁶² Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641 (2010).

⁶³ Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, 641 (2010).

⁶⁴ (E. Ostrom 1990; Agrawal 2001; Cox et al. 2010).

are not a panacea for sustainability; rather, they are empirically observed regularities in successful cases.

Do these eight design principles, devised from the study of local commons, apply also for the governance of global commons? the SESMAD project tested the applicability of these principles to large scale commons. this study utilizes the SESMAD methodology to test whether the design principles apply also to the global commons, using the case study of outer space.

B. The SESMAD Project

The SESMAD project utilizes the SES framework which evolved from the IAD framework. This section presents these three.

“The Institutional Analysis and Development (IAD) framework was designed by Ostrom and her colleagues from the Ostrom Workshop in 2005 to facilitate analysis of institution processes through which individual and collective choices occur. The IAD framework includes analyzing actors, norms, institutional settings, incentive structures, rules, and more. Social scientists have widely adopted the IAD framework to study institutional arrangements and the emerge and changes of institutions over time”.⁶⁵ The IAD framework summarizes “efforts of ... intellectual community to understand the ways in which institutions operate and change over time.”⁶⁶. The IAD framework was also used by many researchers to collect empirical data using a unified framework, allowing for comparing various findings and producing aggregate results.

E. Ostrom (2007, 2009) developed the SES framework as evolution of the IAD framework. “The Social-Ecological Systems framework builds upon the IAD by unpacking the biophysical world's attributes that are acted upon in the action situations to facilitate multidisciplinary efforts toward a better understanding of complex SESs. In this framework, an SES has multiple levels of nested systems. In the first level, the four core subsystems – (i) resource systems, (ii) resource units, (iii) governance systems, and (iv) users – are connected as well as to the social, economic, and political settings and related ecosystems. Each core subsystem comprises second-level variables, which are further composed of deeper-level variables. The SES framework has been proven useful for providing a common set of potentially relevant variables to use in the design of data collection instruments, the conduct of fieldwork, and the analysis of the sustainability of complex SESs”.⁶⁷

⁶⁵ <https://ostromworkshop.indiana.edu/courses-teaching/teaching-tools/iad-framework/index.html>.

⁶⁶ Michael D. McGinnis, An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework, 39 POL'Y STUD. J. 169, 169 (2011)

⁶⁷ <https://ostromworkshop.indiana.edu/courses-teaching/teaching-tools/ses-framework/index.html>.

Cox et al. modified the principles and updated some aspects of the SES framework (action situation field, SES form), and established the SESMAD project - Social-Ecological Systems Meta-Analysis Database. Built on the IAD heritage, SESMAD also has its own specialization, focusing on large-scale social ecological systems of natural resources and pollution. Cox and a group of scholars analyzed a varied set of cases.⁶⁸ Summarizing five key cases, Cox distilled conclusions on the validity of the eight design principles for large-scale systems.

Cox presents the project as follows: “SESMAD is an internationally collaborative meta-analysis project that builds on previous seminal synthetic work on small-scale common-pool resource systems conducted at the Workshop in Political Theory and Policy Analysis at Indiana University. This project is guided by the following research question: can the variables found to be important in explaining outcomes on small-scale systems be scaled up to explain outcomes in large-scale environmental governance?”⁶⁹

Five key case studies were analyzed: (1) governance of Atlantic Bluefin Tuna by the International Commission for the Conservation of Atlantic Tuna;⁷⁰ (2) governance of Indonesian forests through the Suharto and decentralized post-Suharto regimes;⁷¹ (3) governance of ozone-depleting substances by the Montreal Protocol;⁷² (4) governance of pollution problems within the Rhine river in Europe;⁷³ and (5) governance of the Great Barrier Reef in Australia via the Great Barrier Reef Marine Park.⁷⁴

Summarizing and comparing the lessons drawn from these five case studies of large-scale governance of common-pool resources allowed the researchers working on these cases to (i) assess the applicability of Ostrom’s eight design principles to large scale systems, and (ii) examine important variables beyond Ostrom’s eight that may determine success in large scale systems.⁷⁵ They summarize their conclusions as follows:

“While we find support for some of Ostrom’s design principles (boundaries, monitoring, sanctions, fit to

⁶⁸ By October 2023 there were 21 case studies indicated in SESMAD website (link).

⁶⁹ Michael Cox, Understanding large social-ecological systems: introducing the SESMAD project, *International Journal of the Commons* Vol. 8, no 2 August 2014, pp. 265–276.

⁷⁰ Epstein et al. 2014b.

⁷¹ Fleischman et al. 2014.

⁷² Epstein et al. 2014a.

⁷³ Villamayor-Tomas et al. 2014.

⁷⁴ Evans et al. 2014.

⁷⁵ Forrest D. Fleischman, Natalie C. Ban, Louisa S. Evans, Graham Epstein, Gustavo Garcia-Lopez, and Sergio Villamayor-Tomas, Governing large-scale social-ecological systems: Lessons from five cases, *International Journal of the Commons* Vol. 8, no 2 August 2014, pp. 428–456.

conditions, and conflict resolution mechanisms are all supported), other principles have only moderate to weak support. In particular, recognition of rights to organize and the accountability of monitors to resource users were not supported. We argue that these differences are the result of differences between small and large scale systems. At large scales, other kinds of political dynamics, including the role of scientists and civil society organizations, appear to play key roles. Other variables emphasized in common-pool resource studies, such as levels of dependence on resources, group size, heterogeneity, disturbances, and resource characteristics also receive mixed support, pointing to the need to reinterpret the meaning of common-pool resource theories in order for them to be applicable at larger scales.”⁷⁶

The SESMAD project demonstrated that large-scale cases indicate multiple pathways to both success and failure, contingent on different configurations of variables in various contexts.

This study builds on and employs the SESMAD methodology with the goal of assessing the validity of Elinor Ostrom’s design principles in the context of space governance, specifically by analyzing the international regulation and governance of space debris.

C. The SESMAD Applied to Space Debris

SESMAD authors have included various types of Social-Ecological Systems (SES) in the sample frame, such as forest regimes, fisheries, protected areas, and transboundary pollution cases. Among the numerous pressing issues in space governance, such as security/military uses of space, space resource exploitation, space traffic management, and space debris, this study focuses on the debris problem. This falls into the category of transboundary pollution cases and has a direct ecological impact that influences not only humanity's exploration of space but also our use of space-based infrastructure and assets here on Earth. The following describes how the SESMAD methodology will be applied to space debris.

⁷⁶ Forrest D. Fleischman, Natalie C. Ban, Louisa S. Evans, Graham Epstein, Gustavo Garcia-Lopez, and Sergio Villamayor-Tomas, *Governing large-scale social-ecological systems: Lessons from five cases*, *International Journal of the Commons* Vol. 8, no 2 August 2014, pp. 428–456, at 429.

1. The snapshots

Analyzing large-scale resource systems poses a challenge due to their variable nature, which differs significantly from local Common-Pool Resources (CPRs) that may remain regulated in the same way for extended periods. To ensure a more objective understanding of large-scale governance, the SESMAD project employs the concept of a 'snapshot' — a period during which the values of a set of variables in a Social-Ecological System (SES) remain relatively constant. This allows meaningful inferences regarding their values and influences on outcomes. Comparing such snapshots helps illustrate institutional changes and their impact on system governance.

The Space Debris Mitigation Guidelines,⁷⁷ adopted by the UN General Assembly in 2007, represent a unique international document addressing this issue. The guidelines, prepared by an inter-agency committee which members included space agencies of all leading spacefaring nations, potentially influenced leading these and other nations to adopt mechanisms for managing debris generated by their space activities. We therefore use these guidelines as a test point, to examine whether they had a meaningful effect, and set the snapshots accordingly. The two time periods snapshots we chose are: 1996-2006, the ten years just preceding the adoption of the guidelines, and for which data on space debris is available, and 2010-2020, a ten years period starting three years after the adoption of the guidelines. This second snapshot was selected to allow for or take into account an interim period needed to adopt implementing national/domestic regulation and to account for any delay in impact or data/statistics. All in all, the 2007 space debris mitigation guidelines were selected to be tested for efficacy, comparing two ten-years periods, one before and one after the adoption of the guidelines.

2. The SES Framework

Every analysis begins with basic units. The analytical instrument used to identify these units in the SESMAD database is based on the SES framework proposed by Ostrom and updated by Cox for studying large-scale systems. This framework consists of three elements: government systems, actor groups, and environmental commons, as detailed below:

Government systems: a set of institutional arrangements (such as rules, policies, and governance activities) that are used by one or more actor groups to interact with and govern an environmental common. In this context, we will analyze the regulations of space nations dedicated to space debris mitigation during the initial snapshots and the 2007 Mitigation Guidelines. Additionally, international forums addressing space issues, such as the

⁷⁷ https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

United Nations Office of Outer Space (UNOOSA), Committee on the Peaceful Uses of Outer Space (COPUOS) and Inter-Agency Space Debris Coordination Committee (IASD) along with prominent forums of 1.5 and 2-track diplomacy, will be considered.

Actor groups: a group of actors, i.e. of individuals, organizations or nations, which have developed a set of institutional arrangements in order to interact with an environmental commons. Given the limited number of nations with current launching capabilities—namely the USA, China, Russia, India, and the European Union (France)—our analysis will focus on these countries. The burgeoning role of private space companies globally, including those with launching capabilities like SpaceX or Virgin Galactic and others in spacecraft hardware and software production, will also be examined. Additionally, the influence of the scientific community, akin to the scenario with the Montreal Protocol where scientists were primary initiators, on regulations and policies will be explored. Thus, the question whether the space scientists and private space companies genuine actors in space debris regulation or their participation could be understood like a factor that influence on collective actions in that sphere –will be explored in our forthcoming research.

Environmental commons: the concept of environmental commons, unites Resource Systems and Resource Units as initially proposed by Ostrom. It is possible to define environmental commons as phenomenon that is associated with important benefits to certain actor groups, and the presence of which is also associated with negative extraction or emission-based externalities. First of all the question about the nature of CPR appears here. Pollution issues are defined in economy science as classic externality of production. Externalities are primarily associated with overproduction rather than over-appropriation. Thus, the subject of exploration in that cases is split. Let's take the famous example of Montreal protocol – this protocol is about the reduction of ozone depleting substances (ODS) that influence on ozone layer global common pool resource that doesn't play a big role in the production of ODS. Thus, the subject of the analyses is the ODS and the CPR is analyzed in the second row.

The issues of space debris management are different among other pollution cases examined in Common-Pool Resource (CPR) theory. This distinctiveness arises from the nature of the goods produced— the spacecraft (including satellites, rockets, etc.), which determine both the pollution characteristics (e.g. size of objects that pollute the orbit with three variants) and the features of the public good provided (services related to the main satellite services: remote sensing, reconnaissance, communication). Concerns of over appropriation are relevant for space issues, envisioning scenarios where the quantity of spacecraft renders an orbit nonfunctional.

Currently, this is mitigated by the fact that only space nations and a handful of private companies possess the capabilities for space launching. The environmental characteristics are equally crucial, considering the challenging accessibility of the orbit, necessitating the production of a distinct type of spacecraft—rockets.

3. The 8 Design Principles Applied to Space Debris

This paper uses the SESMAD methodology to evaluate whether and to what extent to Ostrom's eight design principles apply to space, using the case study of space debris. The following is the eight design principle and how might they apply to space debris. The principles are quoted twice – the first as they appear in Ostrom's Nobel lecture,⁷⁸ and the second as they appear in Cox' introduction to the SESMAD project.⁷⁹ They are followed by their application to the case of space debris. Some principles have two parts.

Design principle 1: Clearly defined boundaries

Ostrom: 1A. User Boundaries: Clear and locally understood boundaries between legitimate users and nonusers are present.

Cox: 1A Social boundaries. Define who can be the appropriators of the resource.

A key feature of Ostrom's approach is governance by the users. In the case of space, the users depend on the specific sub-sector. For example, military uses of space are limited to a handful of states, while many more states are using satellite communications. In the context of space debris, every state and non-state organization that have assets in space is potentially both a polluter – emitting debris – and adversely affected by space debris. While even states that do not have space assets but procure space-based services are indirectly affected, they are not direct users and the rationale of management-by-users does not mandate their inclusion as such.

Ostrom: 1B. Resource Boundaries: Clear boundaries that separate a specific common-pool resource from a larger social-ecological system are present.

Cox: 1B Biophysical limits. Define territories where the

⁷⁸ Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, 100 AM. ECON. REV. 641, 641 (2010).

⁷⁹ Michael Cox, Understanding large social-ecological systems: introducing the SESMAD project, *International Journal of the Commons* Vol. 8, no 2 August 2014, pp. 265–276.

appropriation could happen.

While outer space is infinite, the problem of space debris is concentrated in Earth orbit. Of these orbits, we chose to focus on the most well-known and well used orbits, for which data on debris is available (the availability of data was the key consideration in this case): low Earth orbit (LEO) with attitude of up to 2,000 km over the Earth's surface, and the geostationary orbit (GEO) with attitude of 35,786 km above the Earth's equator.

Design principle 2: Congruence of rules and conditions

Ostrom: 2A. Congruence with Local Conditions: Appropriation and provision rules are congruent with local social and environmental conditions.

Cox: 2A Congruence of rules to the characteristics of resources and resource users (magnitude and scale of impacts on the CPR system)

As noted in the 'snapshots' section above, the focus of the analysis herein is the 2007 Space Debris Mitigation Guidelines, and therefore they should be evaluated for congruence of appropriation and provision rules with local conditions and environmental conditions. Since all the major spacefaring nations participated in the process of their preparation and they were unanimously adopted by them, one may assume that the appropriation and provision rules satisfy all these nations. However, since polluters are often wary of undertaking significant limitations, there might be insufficient congruence with the environmental conditions in the sense that a higher standard would be more congruent than the agreed-upon baseline standard.

Ostrom: 2B. Appropriation and Provision: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.

Cox: 2B Proportionality - benefits obtained from CPR are proportional to the amount of inputs required in the form of labor, material, or money

Again, since all the major spacefaring nations participated in the preparation of the Guidelines and they were unanimously adopted by them, one may assume that they were satisfied with the distribution of costs and benefits, and that the distribution of costs is proportional to the distribution of benefits. While this may not be said on non-state organizations – notably

commercial space companies - and their allocated costs and benefits, since states, and in particular the U.S., is mindful of the interests of the commercial sector and is actively supporting it, one may assume that the same apply to non-state actors, meaning that also for them the distribution is proportional.

Design principle 3: Collective Choice Arrangements

Ostrom: *3. Collective Choice Arrangements: Most individuals affected by*

Cox: *3. Collective-choice arrangements. Most individuals affected by the operational rules can participate in modifying those rules.*

This principle is only partly displayed in the context of space debris. All the major spacefaring nations participated in the preparation of the Guidelines, and they were later discussed and unanimously adopted both by the UN Committee on the Peaceful Uses of Space (COPUOS) and later the UN General Assembly (UNGA), there was wide yet graduated participation. In this context, the graduated participation provides even a better collective choice arrangement, by which the actors who are both the main polluters and the main adversely affected by the debris are those preparing the rules, then a larger number of states takes part in the adoption of the Guidelines at COPUOS and later all states take part in their adoption by the UNGA. Again, non-state actors, notably commercial space companies, are not represented in any of these forums, but they are indirectly represented by their states, particularly the U.S. All in all, while not all actors affected by the rules could participate in their modification, there is a very high degree of participation, directly and indirectly, and, as important, congruence between roles and rules – between the degree of activities and influence on the rules.

Design principle 4: Monitoring by the Users

Ostrom: *4A. Monitoring Users: Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.*

4B. Monitoring the Resource: Individuals who are accountable to or are the users monitor the condition of the resource.

Cox: *4A Monitors actively audit CPR conditions and appropriator behavior.*

4B Monitors are accountable to or are the appropriators.

While there is no international police, let alone space (debris) police, there is constant monitoring of space debris and its emissions. There is no

centralized monitoring, but some states, especially the U.S., gather space situational awareness (SSA) data that tracks the amount and location of debris in orbit. The major spacefaring nations also track other nations' space activities (mainly for security reasons) and especially any testing of anti-satellite missiles (ASAT missiles). ASAT tests are by far the highest-emitting space activities. UN COPUOS routinely discusses space debris, and together with the Inter-Agency Space Debris Coordination Committee (IADC) there are also multilateral forums monitoring space debris. All in all, monitoring of the users (space actors) and resource (Earth orbits and the amount of debris in them) is certainly made by the users.

Design principle 5: Graduated sanctions

Ostrom: 5. *Graduated Sanctions: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.*

Cox: 5. *Graduated sanctions. Appropriators who violate operational rules are sanctioned according to the context, seriousness and frequency of the offense.*

There are no direct sanctions on violating the Space Debris Mitigation Guidelines – non are provided in the Guidelines, and they are non-legally binding to begin with. However, Article VII of the Outer Space Treaty⁸⁰ and the Liability Convention⁸¹ provide rules regarding liability that may serve as indirect sanctions. In addition, violation of the rules, if exposed at international forums, may lead to reputation damages. In both cases, the liability and the reputation would be proportionate to the violation and its consequences, and thereby graduated.

Design principle 6: Clearly defined boundaries

Ostrom: 6. *Conflict Resolution Mechanisms: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.*

Cox: 6. *Conflict-resolution mechanisms: Appropriators and their officials have rapid access to low-cost arenas to resolve conflicts among appropriators or between appropriators and officials.*

There are no such mechanisms dedicated to space debris, however some mechanisms are available: the Liability Convention has a fairly elaborated

⁸⁰ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies ([link](#))

⁸¹ Convention on International Liability for Damage Caused by Space Objects ([link](#)).

procedure for dispute resolution stipulated in Articles VIII-XX. In addition, there is a voluntary dedicated arbitration rules and procedure: the Permanent Court of Arbitration (PCA) adopted in 2011 the Optional Rules for Arbitration of Disputes Relating to Outer Space Activities⁸² and maintain two lists – one of Specialized Panels of Arbitrators for Space-related Disputes and another of Specialized Panels of Experts for Space-related Disputes.⁸³ Beyond these, there are the regular international tribunals, notably the International Court of Justice (ICJ). While conflict resolution mechanisms do exist, none is dedicated to space debris, i.e., they are not ‘local’ and their efficiency in terms of being rapid and low cost is questionable.

Design principle 7: Recognized right to self-organize

Ostrom: 7. *Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government.*

Cox: 7. *Minimal recognition of rights to organize; the rights of appropriators to devise their own institutions are not challenged by external governmental authorities.*

The Inter-Agency Space Debris Coordination Committee (IADC), which prepared the Space Debris Mitigation Guidelines, presented its work to UN COPUOS, which adopted it and in turn presented it to the UNGA which also adopted it.⁸⁴ In this sense, the right of the users – the spacefaring nations who are members of the IADC to devise their own institutions and rules was not challenged.

Design principle 8: Nested enterprises

Ostrom: 8. *Nested Enterprises: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.*

Cox: 8. *Nested enterprises, because of the nature of environmental problems, even local governance systems needed to be nested within higher-level governance structures.*

⁸² <https://docs.pca-cpa.org/2016/01/Permanent-Court-of-Arbitration-Optional-Rules-for-Arbitration-of-Disputes-Relating-to-Outer-Space-Activities.pdf>.

⁸³ <https://pca-cpa.org/en/about/panels/panels-of-arbitrators-and-experts-for-space-related-disputes/>.

⁸⁴ For the history of the Guidelines see https://www.unoosa.org/pdf/publications/st_space_49E.pdf.

LEO and GEO are orbits nested within outer space and the Earth-space environment. Furthermore, space debris is one issue of space activities, alongside other issues (e.g., military uses, resource exploitation) and general considerations. While the IADC which prepared the Guidelines is dedicated to the issue of debris, UN COPUOS and UNGA which adopted them have a wider scope. More generally, the governance of space debris is nested within the governance of space activities and its various institutions, notably but not exclusively UN COPUOS, the Outer Space Treaty, and the Liability Convention.

4. How We will Apply SESMAD to Space Debris

The analysis of the governance of space debris will include analysis of the basic units – actors, government systems and environmental commons. For this purpose, we will identify the attributes of these units that potentially affect the prospects for collective action.

The actors in this context are mainly states and non-state organizations that have space assets, and thus potentially pollute and simultaneously are affected by space debris. These include spacefaring nations, states that have space assets which launch they procured, and commercial space companies with satellites in orbit. The government system is mainly UN COPUOS, the IADC, and the Space Debris Mitigation Guidelines, but also the Outer Space Treaty and the Liability Convention. The environmental commons are Earth orbits, with a focus on LEO and GEO.

Next, we will consider a subset of social, technological, and institutional attributes drawn from the CPR literature, including other SESMAD studies about the management of global pollution issues, and prior studies on the problem of space debris in order to identify the factors that affect to the actual regulation of the problem and its effectiveness. This will allow us to generate insights concerning the extent to which attributes associated with successful CPR governance in small/local scale, inter-regional scale (e.g., the Rhine River) and global scale (e.g., the ozone layer) CPRs, are associated with successful governance systems.

Eventually, the effectiveness of the Space Debris Mitigation Guidelines will be measured by the adoption of national regulation in leading countries and more so in the statistics on the number of debris pieces and the trends (i.e., the growth rate). The statistics regarding the first snapshot (1996-2006) will be compared to that of the second snapshot (2010-2020), that is just before the adoption of the Guidelines and after their adoption.

In order to compare and display the before and after snapshots, we will prepare the chronological table of the governance of space debris from the launch of the first artificial Earth satellite (Sputnik 1 in 1957) and until today, and the growth of space debris over the years. This will allow the

understanding of the patterns and connections between the governance framework to the amount of debris in orbit.

In addition, we will compare our work with similar works applying the SESMAD to other CPRs. By now there are 21 such case studies.

5. What We Expect to Find (Hypothesis)

This study is still ongoing, and we are yet to fully apply the SESMAD methodology to space debris and extract final findings and conclusions. Based on the five case studies described above and their results, and especially the case of the governance of ozone-depleting substances by the Montreal Protocol which is the closest in nature to the governance of space debris emissions and the Space Debris Mitigation Guidelines, we expect to find:

The researchers of the five case studies found support for some of Ostrom's design principles, but only moderate or weak support for others. We expect to generally have similar findings, with some exceptions. As noted, Dietz, Ostrom and Stern, suggested that many of the general principles for robust governance systems for local resources "also appear to be applicable to regional and global resources, although they are less well tested at those scales."⁸⁵ Araral, on the other hand, suggested that the design principles are not applicable at large scales.⁸⁶ We thus hypothesize the findings to be closer to the predictions of the first, rather than the latter.

Since we are at an early stage, the best predictor for our findings are the aggregate findings of the five case studies, and these were summarized by their lead researchers as follows:

"Comparing the five cases shows varied support for the eight design principles (see Table 1). This directly contradicts recent claims that the design principles are not applicable at large scales (e.g. Araral 2014). Clearly defined social and physical boundaries (principles 1A and 1B) and monitoring of CPR conditions (and to lesser degree user behavior) (principle 4A) were important in all five cases – explaining both relative success and failure. Graduated sanctions (principle 5), fit to local conditions (principle 2A), and (implicit) conflict-resolution mechanisms (principle 6) also received strong support, in four of the five cases. Proportionality (principle 2B),

⁸⁵ Dietz, Thomas, Elinor Ostrom and Paul C. Stern, The Struggle to Govern the Commons, 302 (5652) Science (2003), 1907, 1910.

⁸⁶ Araral, E. 2014. Ostrom, Hardin and the commons: A critical appreciation and a revisionist view. Environmental Science & Policy 36:11–23.

collective choice arrangements (principle 3), and nested enterprises had moderate support (in 2-3 cases each). Whereas, accountability of monitoring to resource users (principle 4B) was not supported in any of the five cases, while minimal recognition of rights to organize (principle 7) was only supported in one case. Overall, the results are somewhat similar to those of Cox et al. (2010), which found strong support for principles 1A, 2A, 2B, 4B, and moderate support for principles 1B, 3, 4A, 5, 6, 7, and 8.

Our results offer support to certain design principles but also highlight differences in their application to small-scale versus large-scale systems. In particular, we suggest that the weak support of principles 4B and 7 could be explained by the scaling up of governance. This is clearest in the case of 4B, which establishes the need for self-monitoring by users or accountability of monitoring to resource users. In large-scale systems, states and international bodies act as monitors thereby altering the direction of accountability. In our cases we found that involvement of other actors, including civil society actors, may substitute for resource users in ensuring an appropriately motivated monitoring system. Further research is needed to clarify how political dynamics and civil society play a role in these accountability relationships.”⁸⁷

Indeed, the prediction of Dietz, Ostrom and Stern, that many (not necessarily all) of the general principles will be applicable to global resources was quite right. The principles regarding boundaries, monitoring, sanctions, fit to conditions, and conflict resolution mechanisms seem to apply to global commons. On the other hand, recognition of rights to organize and the accountability of monitors to resource users were not supported by the five cases, however these principles are observed in the case of space debris, so we do not expect to be able to tell whether or not they are critical.

6. Initial findings

Available statistics demonstrate that there were periods in which the emission of space debris slowed down, even for several years. One such

⁸⁷ Forrest D. Fleischman, Natalie C. Ban, Louisa S. Evans, Graham Epstein, Gustavo Garcia-Lopez, and Sergio Villamayor-Tomas, *Governing large-scale social-ecological systems: Lessons from five cases*, *International Journal of the Commons* Vol. 8, no 2 August 2014, pp. 428–456, at 451-452.

period was from 2002 to 2007, just before the Guidelines were adopted, and later between 2009 – 2016.⁸⁸ These numbers may imply a positive trend of slowing down the debris emission around the time in which the Guidelines were adopted. Wright suggested in 2010, 3 years after the adoption of the Guidelines, that “there is evidence that standard practices are getting better, (especially in the U.S.), which is important given its level of space activity”.⁸⁹ However, as he noted, “years of successful mitigation can be negated by a single large event” such as the ASAT missile tests. Such was the ASAT missile test conducted by China in 2007, which exponentially increased the amount of space debris, and was by far the single event with the largest contribution of space debris.⁹⁰ The fact that this test was conducted by the member-state of IADC, the forum that prepared the guidelines, is telling in terms of the limits of such processes, institutions and instruments. Later ASAT tests conducted by India in 2019 and Russia in 2021 further increased the amount of space debris in orbit, though on smaller scales. The initial findings demonstrate mixed results, of an overall trend of reduced emissions of ‘regular’ space debris while, at least in security context, a less responsible state behavior.

IV. POLYCENTRIC MULTILATERALISM

The previous section explored whether the knowledge accumulated on the governance of local commons, in particular that on polycentric governance and the eight design principles, applies to large scale and global commons. This section examines the application of the said knowledge more broadly to global affairs. If applicable, it may guide us to reimagine the role of the long-standing international institutions.

A. Applying polycentric governance to global affairs

Many theories attempting to analyze international affairs rely on simplified game theory problems and frameworks that do not take into account the many different motivations and impulses that states, non-state actors, and individuals maintain when they are making decisions and policies that affect others on an international level. Scholars often focus on game theory problems that simplify the landscape in which these groups are

⁸⁸ https://swfound.org/media/99971/wright-space-debris_situation.pdf and (figure 3, page 5 of the Report) https://www.hdi.global/globalassets/_local/international/newsroom/hdi_global_specialty_study_space_debris_2023_corpv5.pdf.

⁸⁹ https://swfound.org/media/99971/wright-space-debris_situation.pdf.

⁹⁰ https://swfound.org/media/9550/chinese_asat_fact_sheet_updated_2012.pdf.

operating. By taking an approach that conceptualizes international rulemaking as polycentric governance in global affairs, one obtains a better understanding of the complex way that norms, policy, and institutions are designed and implemented.

Through our research, we demonstrate how a multiplicity of actors are able to find solutions and create norms for a specific issue, space debris, within a complex regime structure that spans several units of analysis.⁹¹ What the SESMAD framework allows is a better way of understanding the whole rulemaking ecosystem. In a multipolar world, it is important to find how these solutions to the collective action problem, as it is manifested in global affairs, may develop so as to promote norms and policies that may mitigate extant issues within a particular commons.

The previous section demonstrated the extent to which the knowledge on local commons is applicable to large scale and even global commons. While this facilitates the second leap (the first being from local commons to global commons, and the second from global commons to global affairs), there is also direct similarity between local commons and global affairs. In both cases there is no top-down, monocentric governance – in local commons it is the local users that are making the rules, not the government, and in global affairs it is the states – users – that make the rules, and not a global government/supreme authority. The lack of a central regulator and enforcement authority is evident in the anarchic structures in both circumstances. Just as small farmers in poor countries lack hierarchical authority to enforce rules, states lack a world government to enforce laws.⁹²

Polycentric action need not preclude the possibility of multilateral action. In fact, it is possible that polycentric action can create state practice and *opinio juris* which, in turn, create international law.⁹³ Different centers of policy creation can allow for policy advancement when other geopolitical factors make state-centered multilateralism less feasible. Discussion of solutions and paths forward can be generated at different levels, even if productive conversations have stalled at the state level. Additionally, multi-stakeholder groups can help to create policy that is inclusive of the interests of a wide-range of actors involved in a particular commons, especially if those actors may be overlooked by state-centered treaties.

Another benefit of polycentric governance is the iterative progression of

⁹¹ Ostrom, V.,(1999). Polycentricity (Parts 1 and 2). In McGinnis, M. (Ed.), *Polycentricity and Local Public Economies: Readings from the Workshop in Political Theory and Policy Analysis*. University of Michigan Press, Ann Arbor, pp. 52–74, 119–138.

⁹² Keohan, R.O. & Ostrom, E. (1994). *Journal of Theoretical Politics*, 6(4), 403.

⁹³ *Identification of Customary International Law*, GA Res 73/203, (11 January 2019, adopted 20 December 2018).

policy solutions that build off of the progress of other groups within the regime complex. Polycentric resource regimes allow for “mutual monitoring, learning, and adaptation of better strategies over time.”⁹⁴ Stakeholders in a variety of groups are afforded the freedom and opportunity to contribute to a more comprehensive understanding of a particular issue and retain the ability to contribute solutions to the overall for the overall regime complex. As with space debris mitigation measures, scientists, states and groups of states can contribute policy solutions without stalling productive conversations, a potential contingency when the policy process is controlled by a top-down monocentric unit.

The impact of these polycentric groups in the context of the space debris issue is evidenced in the current range of policies directed at the collective action problem of space debris. A historical example of this was the first ever sanction issued by the US Federal Communications Commission against Dish Network for failure to mitigate space debris.⁹⁵ While this is the first of such an action, it demonstrates the progress that can be achieved under a polycentric governance system. What started as a scientific paper in 1987 outlining a potential problem, has blossomed into a complex policy network that is seeing real world applications.

Scholars from various disciplines have developed the concept of “polycentricity,” as was introduced above, but as a reminder polycentric governance may be considered a regulatory system—sometimes referred to as a regime complex,⁹⁶ - that “[is] characterized by multiple governing authorities at differing scales rather than a monocentric unit[,]” according to Professor Elinor Ostrom.⁹⁷ In other words, this is a system characterized by the confluence of myriad stakeholders, including both state and non-state actors,⁹⁸ interacting with each other in a coordinated fashion and ideally adding some value to the overall regime.⁹⁹ There is an opportunity within such a system for “mutual monitoring, learning, and adaptation of better

⁹⁴ Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global Environmental Change*, 20(4), 552.

⁹⁵ Clayton, A. (2023). US government issues first-ever space debris penalty to Dish Network. *Guardian* ([link](#)).

⁹⁶ See, e.g., Cole, *supra* note 26, at 395; Scott J. Shackelford, *Toward Cyber Peace: Managing Cyber Attacks Through Polycentric Governance*, 63 Am. U. L. Rev. 1273 (2013).

⁹⁷ Elinor Ostrom, *Polycentric Systems for Coping with Collective Action and Global Environmental Change*, 20 Global Envtl. Change 550, 552 (2010).

⁹⁸ Julie Black, *Constructing and Contesting Legitimacy and Accountability in Polycentric Regulatory Regimes*, 2 Reg. & Governance 137, 137–38 (2008).

⁹⁹ Ostrom et al., *supra* note xx, at 552.

strategies over time.”¹⁰⁰

Proponents of polycentric governance claim that top-down planning by national officials with extensive external resources is unnecessary to build efficient regimes to sustainably govern common pool resources,¹⁰¹ arguably including the space commons. This concept builds from the regime complex literature by recognizing the benefits and drawbacks of multilevel regulation, as well as the importance of multi-sector localized self-organization.¹⁰² While these principles were originally developed in other contexts, Professor Ostrom and others have worked to extend them to new frontiers. These scholars advocated targeted measures through small, issue-specific forums to help manage global collective action problems lest inaction hasten a worst-case scenario.¹⁰³ However, there are both moral and political problems with this approach. Thus, it is important critically assess the application of polycentric theory to the space commons.

It is helpful to analogize from a perhaps more familiar context of climate change. Although the atmosphere is by definition global, the causes and effects of climate change vary from region to region.¹⁰⁴ “[A]ctions taken at a small scale” have an impact on the global climate change problem—insulating housing and buying more fuel-efficient cars could alone help reduce energy consumption worldwide by thirty percent.¹⁰⁵ As applied to space, this principle could mean that actions taken by individual firms or nations could help enable more sustainable management of the space commons, similar to how practicing cyber hygiene can help mitigate an array of cybersecurity challenges. But, as Elinor Ostrom reminds us, “[t]rying to solve the problem of providing a public good is a classic collective action dilemma[.]”¹⁰⁶

Professors Robert Keohane and David Victor have joined Professor Ostrom in investigating the benefits and drawbacks of minilateral fora to manage global climate change that could reach an agreement more easily than is possible through the UNFCCC process.¹⁰⁷ This approach has been tried

¹⁰⁰ *Id.*

¹⁰¹ Elinor Ostrom, *Polycentric Systems as One Approach for Solving Collective-Action Problems* 2-3 (Ind. Univ. Workshop in Political Theory and Policy Analysis, Working Paper Series No. 08-6, 2008).

¹⁰² See McGinnis, *supra* note 84, at 7.

¹⁰³ See Keohane & Victor, *supra* note 10, at 18; Ostrom, *supra* note 17, at 5.

¹⁰⁴ See Ostrom, *supra* note 17, at 16.

¹⁰⁵ *Id.* at 5 (citing Michael P. Vandenberg & Anne C. Steinemann, *The Carbon-Neutral Individual*, 82 N.Y.U. L. Rev. 1673, 1700 (2007)).

¹⁰⁶ Ostrom, *supra* note 11, at 5.

¹⁰⁷ See *id.* at 6–7; Ostrom, *supra* note 17, at 15–16.

over the years in the atmospheric governance context such as with the George W. Bush Administration's the Major Emitters Forum, and when President Obama met with the BASIC group (Brazil, South Africa, India, and China) in 2009.¹⁰⁸ However, the 17th UNFCCC Conference of the Parties underscored the continuing importance and potential of multilateral engagement, as well as the fluidity of multipolar politics as seen in the alliance between the European Union and less developed countries.¹⁰⁹ This conclusion was reinforced by the success of the 2015 Paris Agreement despite the Trump Administration's disengagement, but even this agreement has been described as polycentric in its structure and scope.¹¹⁰

The proven merits of polycentric governance and much of the design principles for robust governance systems apply, therefore, also to global affairs. In terms of policy recommendations, this paper suggests a polycentric approach to global affairs and polycentric global governance, what we call 'polycentric multilateralism'. Building on this allows us to reimagine the roles of the long-standing multilateral institutions.

B. Reimagining the Roles of Multilateral Institutions in the Space governance.

In polycentric multilateralism, the long-standing multilateral institutions – primarily the various UN organs – would continue to play the key role in global governance, but they will not do so alone. Other forums and decision-making centers ('governance centers') would complement their work. Governance that is multi-level, multi-purpose, multi-type, and multi-sectoral in scope¹¹¹ would complement the top-down governance model favored throughout much of space governance history. An 'all-of-the-above' approach would help policymakers reimagine the role of existing international institutions as less of monocentric decision-making centers and more as connecting hubs that support and coordinate emerging polycentric

¹⁰⁸ See Keohane & Victor, *supra* note 10, at 6; John Vidal, et al., *Low Targets, Goals Dropped: Copenhagen Ends in Failure*, Guardian, (Dec. 18, 2009), <http://www.guardian.co.uk/environment/2009/dec/18/copenhagen-deal>.

¹⁰⁹ See, e.g., Richard Black, *Climate Talks End with Late Deal*, BBC News (Dec. 11, 2011), <http://www.bbc.co.uk/news/science-environment-16124670> (reporting on the outcome of COP17).

¹¹⁰ *A Challenge for the 2015 Paris Climate Agreement*, Robert Stavins (Feb. 2, 2015), <http://www.robertstavinsblog.org/2015/02/02/a-challenge-for-the-2015-paris-climate-agreement/>.

¹¹¹ Michael D. McGinnis, *An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework*, 39(1) Policy Studies Journal (2011), 169.

networks. We call it ‘polycentric multilateralism’. This approach would reinvigorate the existing institutional system to better respond to contemporary and future challenges (i.e., space debris, space security, space resource exploitation). A polycentric structure would be better adapted to the reality of global politics, including of power shifts and power diffusion.

Polycentric multilateralism may also include initiation and support of multiple regional and issue-specific forums of various types (e.g., the Arctic Council, the Paris Accord), and an ICANN-style nonprofit for registration of space priority and resource rights. An additional recommendation may be a mechanism to facilitate information diffusion across the system of norms and rules created by various actors and forums. It may also require a reconceptualization of the role of space exploration corporations in space governance. These corporations (e.g., SpaceX, Blue Origin) undertake projects to commercialize Earth’s orbit, colonize outer space, mine space resources, and establish installations. They gradually undertake roles with public nature, yet the nature of their internal governance and their ‘seat at the table’ of decision-making forums remain purely private. Such reconceptualization should consider taking a functional approach, adapting corporate rights and duties when they undertake roles or exercise powers with public nature.

The move to polycentric space governance is a dramatic change of affairs from the U.N. system that has long encouraged the progressive development of international law and its codification by building consensus.¹¹² Though umbrella organizations may exist, such as the UNFCCC or COPUOS, the importance of polycentric action incorporating multiple scales and sectors should not be ignored.¹¹³ This transition—or, in a worse-case scenario, fragmentation—of space governance could foreshadow what might occur in other frontiers. To help maintain the relevance of existing treaty systems in these domains, it is imperative that the traditional CHM concept give way to modern regimes that reflect the governance lessons gleaned from the Ostrom Design Principles, as well as the IAD and SES Frameworks, such as by clarifying property rights and stimulating sustainable development while also promoting international peace and security such as through effective monitoring and dispute resolution. This, for example, could include infusing sustainable development policies at multiple regulatory levels, including nationally, as the Obama Administration attempted in its 2010 National

¹¹² U.N. Charter, pmbl., art. XIII; *see also* Shackelford, *supra* note 91, at 135 (arguing that the move away from U.N.-centered multilateral treaty making is a dramatic change in affairs in the governance of outer space).

¹¹³ *See* McGinnis, *supra* note 84, at 7.

Space Policy.¹¹⁴

The 2010 COPUOS declaration is instructive as to the current state of space governance. There, the United States argued that “the international community must come together to measure and reduce the risks to space operation for all[,]”¹¹⁵ while also urging states to use national laws to implement needed reforms. Russia called for the implementation of existing agreements in the face of technological advancement and growing commercial interest lest a space arms race commence.¹¹⁶ The former Libyan government stressed the need to address space junk.¹¹⁷ Pakistan argued that space was part of the CHM, and so all military activities should be forbidden.¹¹⁸ In the end, Zimbabwe called for the resolution to be tabled, which it then was.¹¹⁹ This meeting underscores that COPUOS is now little more than a “talking shop,” as asserted by Mr. Doyle,¹²⁰ but also that there is recognition that space law is incomplete, especially with regards to space weaponization and space junk. Many of the multilateral space treaties, including the OST, are more aspirational documents than binding accords with enforceable obligations. In part because of these governance gaps, new national space regulations and norms may be emerging, which, through the influence of State and non-State actors, may help clarify legal ambiguities. States in particular have become more active in regulating space activities, resulting in movements to increase space commercialization and potentially make space law more national.

CONCLUSION

This paper provides both empirical and theoretical support for a polycentric approach to address transnational challenges.

Polycentric governance regimes that are multi-level, multi-purpose, multi-type, and multi-sectoral in scope¹²¹ could complement the top-down governance model favored throughout much of space governance history. An

¹¹⁴ See NSP, *supra* note 102, at 5.

¹¹⁵ Press Release, U.N. General Assembly, Strength of International Space Law to Prevent Militarization of Outer Space, U.N. Doc. GA/SPD/458 (Oct. 14, 2010), <http://tinyurl.com/hqklalk>.

¹¹⁶ *Id.*

¹¹⁷ *Ide.*

¹¹⁸ *Id.*

¹¹⁹ *Id.*

¹²⁰ See Doyle, *supra* note 234 (Interview with Steven Doyle).

¹²¹ Michael D. McGinnis, *An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework*, 39(1) Policy Studies Journal (2011), 169.

‘all-of-the-above’ approach would help policymakers reimagine the role of existing international institutions as less of monocentric decision-making centers and more as connecting hubs that support and coordinate emerging polycentric networks. We call it ‘polycentric multilateralism’. This approach would reinvigorate the existing institutional system to better respond to contemporary and future challenges (i.e., space debris, space security, space resource exploitation). A polycentric structure would be better adapted to the reality of global politics, including of power shifts and power diffusion.