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2016 JANA ROBINSON

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ABSTRACT

This study concentrates on whether the spacepower projection strategies of China and Russia, as communicated through their actions, key initiatives and public diplomacy positions, will, in the near future, undermine or advance global efforts to preserve the stability of the space environment and sustainability of outer space activities. In order to arrive at key findings, the analysis presented in this study is guided by two theories, the *Astropolitik*, a well-established spacepower theory of Everett C. Dolman, and the "preventive arms control in space" theory of Max Mutschler.

It was concluded that arms control in space will not advance space security and prevent systemic destabilization of the space domain, and formal top-down arms control does not effectively restrain counterspace activities[1]. It was likewise concluded that there exists a high probability (i.e. possibly greater than 75%) of near-term space 'incident' among the U.S., Russia and China.

To prevent an escalatory spiral leading to conflict in space, the U.S. should continue to engage China and Russia (including in multilateral venues) in an effort to adopt space transparency and confidence-building measures (space TCBMs). However, these measures on their own do not have sufficient authority or garner adequate compliance to serve as a decisive deterrent in all, or even most, geopolitical scenarios. Accordingly, TCBMs need to be accompanied by sound and robust space crisis management.[2] Together, they can enhance space security and contribute to the stability and sustainability of the space domain.

The key contribution of this study to the theoretical and practical discussions concerning space security is an in-depth analysis of two contrasting propositions for the near-future governance of space activities, and suggesting a realist path forward. Findings of this study should provide a solid basis for scholars to further refine the spacepower theory of Everett Dolman assisted by researched arguments about the shortcomings of arms control in space.

[1] Counterspace activities in this context are the multifaceted capabilities development of China and Russia that are aimed at disrupting or destroying U.S. space architecture.

[2] The main focus of space crisis management are efforts to identify those situations that are conducive to threats to space assets and related services with the goal to preserve a stable space environment (source: Jana Robinson, "Space Crisis Management: Europe's Response," *European Space Policy Institute* 44 (February 2013): 20, http://www.espi.or.at/images/stories/dokumente/studies/ESPI_Report_44.pdf)

KEYWORDS

arms control in space, astropolitics, Astropolitik, counterspace activities, space governance, space crisis management, space security, spacepower

1. INTRODUCTION

There are few subjects that will gain more prominent attention in the coming years than space security. This is largely a function of the immense level of dependency on space assets by a vast range of civil, commercial and military actors. In short, space has become a vital resource and domain for daily life on Earth. It is not an overstatement that the disruption of, or damage to, space capabilities would have instant and far-reaching economic, political, and geostrategic consequences.

From the outset, the space age was marked by strategic competition between the U.S. and USSR. With new actors, technologies, and greater dependence on space applications and services, however, space security challenges cannot be merely extrapolated from the Cold War experience, but need to take into account the new environment of the 21st century. The complex terrestrial and maritime geopolitical risks of our time inevitably spill into space. Space-related accidents, 'incidents' or conflicts are directly linked to, or have an impact on, terrestrial developments. In addition to geopolitics, the post-Cold War space environment has changed dramatically, marked by new players, technologies and increased dependencies and vulnerabilities.

Beyond the two traditional space powers, orbiting satellites are now operated by some seventy governmental entities, and commercial and academic satellite operators.[3] New actors are changing the geostrategic space environment and have already begun to shape the future governance of space. Commercial space entered the picture in a more visible way over the past decade, especially in the U.S., where the government has both regulated and incentivized commercial space efforts. U.S. companies such as Blue Origin, Virgin Galactic, or Scaled Composites, are emerging on the space scene. Hybrid government-commercial arrangements have already occurred, as well as some fully commercial ventures. Moreover, the commercial space industry is increasingly relevant to

[3] The Union of Concerned Scientists provides through its database public information concerning the estimated number of active satellites orbiting the Earth. Based on this database, there were 1381 active satellites in orbit as of March 2016. It can be accessed at the following link: http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellitedatabase.html

governmental civil and military space programs and is no longer limited to the construction, launch and operation of communications satellites. This is especially true in the U.S. where the government seeks to reduce taxpayer spending by making greater use of commercial capabilities.[4]

The growing ambitions of countries in space are gradually being followed by concerns over how to protect space systems that enable this multitude of critical services and capabilities. It is proper, therefore, to view space as another domain vulnerable to military incidents or conflict and not a "sanctuary", as many would wish it to be, and even mistakenly believe it is. Although space threats emanating from natural hazards (e.g. space weather, near-Earth objects, etc.) and technical mishaps warrant genuine concern, this dissertation focuses on the intentional disruption of space operations, and even destruction of space assets, as they would generally involve larger, and more complex geopolitical stakes and knock-on effects.

Among the new actors in space, China has risen as the most prominent player. In addition, Russia, led by President Putin, is pursuing an ambitious and aggressive foreign policy that has, to date, resulted in a sharp deterioration of its relations with the U.S. and Western Europe. Putin's Russia is striving to regain "great power" status and perceives itself to be an influential and autonomous global actor with a wide-ranging sphere of activity. The Kremlin perceives the international system as potentially dangerous and generally stacked against it where the only way to succeed is to act aggressively.[5]

The U.S., Russia and China have the ability to use space-related hard and soft power to achieve certain of their priority objectives. The European countries, including the EU, seem to, at least for now, rely on the soft power (read diplomacy) only. Complicating this picture further are the very different political systems that govern these countries. China is run by a one-Party authoritarian system. Russia, which advertises itself as democratic, is likewise ruled by an authoritarian leadership structure. The U.S. and European countries are true democracies. These realities permeate nearly every aspect of efforts to maintain a stable space environment.

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[4] Jeff Foust, "A Decade into the New Spaceflight Era, a Mixture of Frustration and Optimism," *Space News* (17 October 2014). http://spacenews.com/42228a-decade-into-a-new-spaceflight-era-a-mixture-of-frustration-and-optimism/

[5] Romancov, Michael, "Rusko a jeho pohled na mezinárodní systém: výzvy pro ČR a střední Evropu," *Acta Politologica*, vol.1, no.2 (2009): 112, http://acpo.fsv.cuni.cz/ACPOENG-15-version1-romancov_01_02_merged.pdf

2. RESEARCH QUESTION AND METHODOLOGY

Three actors – the U.S., Russia and China – will, at least for the foreseeable future, largely determine the viability of operating safely in space. As these three actors do not share a common assessment of the threat environment, this study seeks to determine how these space relationships and interactions will evolve. Specifically, the study concentrates on whether the space power projection strategies of China and Russia, as communicated through their actions, key initiatives and public diplomacy positions, will undermine or advance global efforts to preserve the stability of the space environment and sustainability of outer space activities.

The primary research question of this study is: *Will the emergence of China and re-assertion of Russia, through both soft and hard power means, as major space-faring competitors to the U.S., ultimately serve to strengthen or weaken the stability in the space domain*?

The study examines the characteristics of Russia's and China's counterspace activities, as well as their diplomatic outreach. In this context, the linkages between the civilian and military aspects of their space programs are explored to permit a better understanding of where the line is drawn between legitimate, responsible uses of space and those that could have serious negative consequences. Not surprisingly, space security is profoundly influenced by technological advances. Accordingly, the study examines both the broader policy aspects of space security as well as some specific operational capabilities, as these are inevitably intertwined. It should be noted that the scope of this study does not permit a thorough assessment of these countries' overall space programs or their broader national goals in space.

The study begins by investigating the basic tenets of space security of the U.S., China and Russia, including key security policy objectives of these nations in this domain (Chapter 2). It then details how China and Russia presently use space to project power as well as U.S. and European responses (Chapter 3). Specifically, this Chapter first reviews, at some length, nuclear and ballistic missile-related arms control and export control agreements and associated transparency and confidence-building measures (TCBMs). The reason for this comprehensive overview is to provide a better understanding of the important lessons/precedents learned from these experiences for space governance (summarized in bullet points at the end of section 3.1.). The second part of the Chapter provides a survey of Russia's and China's activities in the principal international space-related

venues in order to demonstrate how they use space to project their soft and hard power globally (section 3.2.). Finally, it looks at the U.S. and European reactions to those space arms control initiatives that have been put forward to date (section 3.3.).

Subsequently, the study examines areas of potential conflict and cooperation, including likely tipping points (Chapter 4). The study then proposes how the global space relationship can be stabilized in the near-term (Chapter 5). This Chapter starts with a review of the lessons learned from terrestrial crisis management (section 5.1.). It next offers a comparative assessment of *preventive arms control in space* versus *Astropolitik* as models that can be applied to future space activities (section 5.2.), as well as what risk-mitigating measures and space crisis management tools could be realistically adopted by the U.S., Europe, and other allies. This chapter also offers recommendations on the most effective means of predicting destabilizing behavior and putting in place preemptive and deterrence-oriented policy measures to avoid, or better manage, future crises. The key research findings and their relevance to the theoretical argumentation presented are summarized in the conclusion (Chapter 6).

In order to arrive at key findings, the analysis presented in this study is guided by two theories which are measured against the facts and evidence revealed through the research. The study assesses and contrasts *Astropolitik*, the well-established spacepower theory of Everett C. Dolman, a professor at the School of Advanced Air and Space Studies at Air University, described in his publication "Astropolitik: Classical Geopolitics in the Space Age"[6], and the "*preventive arms control in space*" theory of Max Mutschler, Researcher at Bonn International Center for Conversion, as outlined in his 2013 publication entitled "Arms Control in Space: Exploring Conditions for Preventive Arms Control"[7].

These two theories were selected for the following reasons. Dolman's *Astropolitik* is one of the only comprehensive and well-developed space theory that combines the security aspects of space activities and geostrategy (defined by Dolman as the strategic application of new and emerging

[6] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002).
[7] Max Mutschler, *Arms Control in Space: Exploring Conditions for Preventive Arms Control* (London: Palgrave Macmillian, 2013).

technologies within a framework of geographic, topographic, and positional knowledge[8]). Max Mutschler's "*preventive arms control in space*" concept serves as the opposite point of departure. Importantly, discussions on arms control in space are a key component of assessing the power projection capabilities of Russia and China in space.

A believer in space arms control, Mutschler forms the antipole of Dolman and his Astropolitik. Moreover, it is one of the only theoretical works in the arms control arena for the space domain in Europe. The choice of these theories was made with a view toward expanding the theoretical foundations of the political aspects of spacepower and its links to the terrestrial environment. This exercise also acknowledges the requirement to treat space as a separate and unique domain in which it would be too perilous to rely on traditional arms control mechanisms, not least because of the difficulty of defining what constitutes a „space weapon".

Max Mutschler focused his work on the issue of the "weaponization" of space, arguing that under certain conditions (i.e. interest-constellation conducive to cooperation plus the possibility of verification, and the expectation that cooperation offers balanced gains for all actors) preventive arms control in space, as a key element of ensuring stability in space, *is* possible. He concludes that an international regime that creates conditions for preventive arms control can emerge when three different scenarios (based on theories of neoliberalism, neorealism, and constructivism, respectively) converge:

- in situations that resemble the Prisoner's Dilemma[9] and the testing of the respective weapons technology can be verified (*interests* as the key variable);
- states that are approximately at the same level of technological capability with regard to the weapons technology that should be controlled (*power* as the key variable); and
- if states learn that – due to interdependence – arms control improves their security more than unilateral armament (*knowledge* as the key variable).

[8] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002), 60.

[9] The prisoners' dilemma is the best-known game of strategy in social science. It explains what governs the balance between cooperation and competition. For example, arms races between superpowers or local rival nations offer an example of the dilemma. Both countries are better off when they cooperate and avoid an arms race. Yet the dominant strategy for each is to arm itself heavily.

He postulates that arms control in space is possible only if a learning process has transformed a situation from a Deadlock game[10] to a Prisoner's Dilemma situation (and where verification is a key variable). This is to be accomplished by an epistemic transnational community that would ideally emerge from scientific cooperation in the area of space exploration.[11]

For Mutschler, the ratification of the Outer Space Treaty (OST) by both the U.S. and the Soviet Union in 1967, as well as conclusion of some of the terrestrial Cold War arms control agreements which included space-related provisions, are a proof that it is possible to establish an international preventive arms control regime. Mutschler's conclusions with regard to terrestrial arms control agreements included the notion that the Anti-Ballistic Missile (ABM) Treaty and the Strategic Arms Limitation Talks (SALT) process contributed to international security by reducing tensions between the superpowers, were a cornerstone of superpower detente, and served as an example that when two sides share certain *interests*, their security can be improved by cooperation. He makes an analogy to the Prisoner's Dilemma concept, where the ABM arms control regime was the solution to the collective action problem.[12]

The *power* aspect, according to Mutschler, was important too, as the Soviet Union looked favorably on the Anti-Ballistic Missile (ABM) Treaty due to their acknowledged weakness in this area of technology.[13] Mutschler argues, that the third element – *knowledge* – is the key ingredient to a successful international regime of preventive arms control. For this he looked to an epistemic community of American scientists and strategists, who understood the potential negative consequences of the quest for superiority by arming in general, and particularly by arming with ABMs. This learning process, according to him, transformed the situation structure from a Deadlock Game to Prisoner's Dilemma.[14]

Dolman's theory assesses how the physical attributes of outer space and characteristics of space systems shape the application of spacepower. He treats space as merely another geographical

[10] In Deadlock game, each player does better defecting no matter what his partner does. Unlike the prisoner's dilemma though, it is better for them to both defect than to both cooperate. This is called deadlock because the two players will decide not to cooperate. This situation sometimes arises when two countries do not want to disarm so fail to reach arms control agreements.
[11] Max Mutschler, *Arms Control in Space: Exploring Conditions for Preventive Arms Control* (London: Palgrave Macmillian, 2013), 15-19 and 210-215.
[12] Ibid. 100.
[13] Ibid. 108.
[14] Ibid. 120.

environment with specific features, just as land, sea, air, and cyberspace have their special characteristics and limitations. Dolman's theory is constructed on geopolitical principles, often drawing on the writings of Sir Halford John Mackinder and Alfred Thayer Mahan, and establishes a fresh look at the connection between space and national security.[15]

Dolman perceives space as another arena for classic great power competition where scenarios familiar to other traditional warfighting domains (i.e. land, sea, and air) will most likely repeat themselves. He assumes geopolitical sources of power in outer space and suggests how space can be dominated through military means. He describes orbits, regions of space, and launch points as geopolitically vital assets over which states will likely compete for strategic control.[16]

Dolman's *Astropolitik* is, in his words: "the extension of primarily nineteenth- and twentieth-century theories of global geopolitics into the vast context of the human conquest of outer space", and, more broadly, "the application of the prominent and refined realist vision of state competition into outer space policy, particularly the development and evolution of a legal and political regime for humanity's entry into the cosmos".[17]

In sum, Dolman defines *Astropolitik* as a "determinist political theory that manipulates the relationship between state power and outer space control for the purpose of extending the dominance of a single state over the whole of the Earth".[18] For the purpose of clarity, he also defines *astropolitics* as "the study of the relationship between outer space terrain and technology and the development of political and military policy and strategy.[19] He emphasizes that *Astropolitik* is not an inevitable, but only one of the possible outcomes of an ongoing astropolitical analysis, and not sought after or desirable.[20] In his view, the ultimate benefit of *astropolitics* and A*stropolitik* is "a full and heuristic understanding of the geopolitical determinants of space, an

[15] John B. Sheldon and Colin S. Gray, "Theory Ascendant? Spacepower and Challenge of Strategic Theory," in *Toward a Theory of Spacepower: Selected Assays*, ed. Charles D. Lutes et al. (Washington DC: National Defense University Press, 2011), 10.
[16] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002), 60-84.
[17] Ibid. 1.
[18] Ibid. 15.
[19] Ibid.
[20] Ibid. 15.

application of the assumptions of realism to the astropolitical model and, in the end, an economically robust and peaceful exploration of the cosmos by humanity".[21]

He suggests that it is likely that some state or states will employ the principles of *Astropolitik* and, as a consequence, may come to dominate space. In this case, he notes, it should be hoped that it is a benign dominance. He asserts that *Astropolitik* offers a pragmatic approach that can be used effectively (e.g., commercial activities, space traffic management, and productive economic advantage etc.), or maliciously, depending on the actor. Even if space dominance is benign, the, the consequences may not be (based on lessons learned from the history of geopolitically-based Realpolitik strategies of dominance).

In this connection, he also reminds the reader that a non-weaponized model for space is utopian, as the military and counterspace activities have been present throughout the entire history of space exploration. He explains that states must anticipate increasing global resource and market competition (including among democratic states) and that stability can only be attained by balancing strategies based on mutual positions of strength. This especially applies to democratic states as they are more susceptible to "first strike" attacks due largely to their open societies and often protracted consensus-building.[22]

Although Dolman acknowledges that it is likely impossible to find a compromise between balance-of-power realists (believing in maintaining effective means for war as the best guarantor of peace) and pacifists (opposed to war or violence of any kind), he offers *Astropolitik* as a means to an economically robust and peaceful exploration of space through a better understanding of the geopolitical determinants of space combined with the application of the tenets of realism to the Astropolitical model.[23]

He establishes the following neoclassical Astropolical dictum: "who controls low-Earth orbit controls near-Earth space. Who controls near-Earth space dominates Terra. Who dominates Terra determines the destiny of humankind."[24] Dolman's theory challenges conventional thinking about space when he suggests that it is desirable to control what he terms "Terra" (or Earth). Another

[21] Ibid. 7.
[22] Ibid. 5.
[23] Ibid. 7.
[24] Ibid. 1-8.

astropolitical region to be controlled is what Dolman calls Terran (or Earth space), as it does not only guarantee long-term control of space, but, importantly for this study's analytical framework, provides near-term advantage on the terrestrial battlefield. In the longer run, Dolman predicts, focus will inevitably turn to Lunar (or Moon Space), and Solar space. Dolman shapes an *Astropolitik* policy for the U.S. which involves controlling "Earth Space".

The individual regions are described in Table 1 below.

Terra (or Earth)	Earth including the atmosphere stretching from the surface to just below the lowest altitude capable of supporting unpowered orbit
Terran (or Earth space)	The lowest viable orbit to just beyond geostationary altitude (about 36,000 km)
Lunar (or Moon Space)	The region just beyond geostationary orbit to just beyond lunar orbit
Solar Space	Everything in our solar system beyond the orbit of the Moon

Table 1: Everett Dolman's four regions of space (Source: Astropolitik: Classical Geopolitics in the Space Age)[25]

Dolman maintains that for a state to remain sovereign it must, at a minimum, prevent another state from gaining vital control of strategic locations, pathways and chokepoints.[26] It is already a reality today, that space operations provide a potentially decisive advantage for the militaries of the U.S. and Russia, and increasingly China. Dolman further emphasizes that with the growing importance of space technology (and, therefore, increasing vulnerabilities), control of space by one dominant power is increasingly essential. If put into practice, however, *Astropolitik*, Dolman emphasizes, must be "fully understood, monitored and aggressively culled".[27]

Returning back to the AMB Treaty example, Dolman points out that although it placed strict constraints on the ability of the U.S. and the Soviet Union to defend themselves from missile attack, it was worse than the deployment of an effective AMB defense that would eliminate the threat of guaranteed retaliation (i.e. the 'second strike' capability deterring a crippling 'first strike'). In addition, neither side completely eliminated their ability to research and test ABM capabilities and two ABM sites were allowed each side (one to protect the respective capitals and another for research and development).[28]

[25] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002), 69-70.
[26] Ibid. 60-61.
[27] Ibid. 168.
[28] Ibid. 159-160.

Dolman argues that the U.S. took the moral high ground by abandoning efforts to protect Washington, while the USSR deployed and maintained, for at least three generations, an ABM perimeter around Moscow. The U.S. saw that it was not proper to spend large sums of money to protect Washington, while not providing the same protection to other cities. In addition, such limited protection did not reduce the prospects for nuclear war.[29] This argument challenges Mutschler's proposition for a preventive arms control regime and related conditions.

Dolman maintains that the major classifications of issues common to sea, air and space law (i.e. delimitations, sovereignty, registration and liability) are all contentious.[30] He explains, moreover, that the current cooperative space regime emerged from contentious situations (designed to limit confrontations). Although space flight was directly associated with ballistic missile defense (BMD) and nuclear weapon development (i.e. fear was a key factor), the current cooperative structure is fragile, as it was treated as being isolated from these terrestrial threats (as manifested, for example, in the OST's non-appropriation principle). In short, space cooperation was a cover to buy time to prevent a potential conflict.[31] This approach, according to Dolman, stifled exploration and positive competition. He believes that this system is unsustainable.[32]

Dolman does not share a view promoted by many liberal political thinkers that a common belief in cooperation is due to the reality that all humans are "on one boat here", that nations can create a 'habit' of cooperation, and that the complexity of space exploration can only be accomplished by a united human race. This liberal view foresees an increasing role for the UN which would, eventually, establish a global government that would eliminate interstate wars. Dolman notes that the realist tradition does not view this as a likely possibility, but does not dismiss it entirely. His view is that of a realist, where competition goes hand-in-hand with cooperation, but where competition is a measure by which success is judged.[33]

[29] Ibid.
[30] Ibid. 114.
[31] Ibid. 89-109.
[32] Ibid. 152.
[33] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002), 168-173.

3. KEY FINDINGS

After a careful review of the match-up between real world evidence and the theoretical constructs used for this study, the following findings are offered:

It was concluded that there exists a high probability of a near-term (i.e. 2-3 years) space 'incident' among the U.S., Russia and China. This view is supported by evidence concerning the patterns of behavior of these two major U.S. competitors. It is also a function of the increasingly seamless connection that has been built up over time between terrestrial and maritime disputes and the space assets that inform and support them.

An analysis of the arguments laid out by Max Mutscher revealed that preventive arms control in space will not advance space security and prevent systemic destabilization of the space domain. It was likewise discovered that formal top-down arms control mechanisms do not effectively restrain military activities in space. Indeed, terrestrial examples showed that arms control treaties rarely prevent the development, testing, and even deployment of restricted technologies (e.g. ABM Treaty, NPT etc.). Accordingly, arms control and collective-security arrangements do not offer a superior deterrent to that of traditional balance of power.

To prevent an escalatory spiral leading to conflict in space, the U.S. should continue to engage China and Russia (including in multilateral venues) in an effort to adopt space transparency and confidence-building measures (TCBMs). The benefits of such agreements derive from politically and morally (if not legally) binding states to more responsible behavior in space, disciplined by peer pressure. Put simply, space TCBM-related agreements have the potential to dampen the temptation of China and Russia to engage in provocative or even hostile actions in space, but not eliminate them. These measures also usefully create a justification for U.S. and allied penalties for such violations of space behavioral norms.

Importantly, TCBMs also help avoid misconduct, misperceptions, miscalculations, and incidents, which can precipitate a crisis. In addition, TCBMs incorporated in existing Treaties are the connective tissue for substantive collaboration even with adversaries (e.g. non-interference with national technical means of verification, etc.). Finally, the level of transparency among states is a barometer of the status of diplomatic relations and can provide valuable early warning.

The study further concluded that TCBMs alone will not prevent an "incident" or a more serious space contingency. This is a function of these measures not having sufficient authority or compliance to act as a deterrent in certain geopolitical scenarios. Another factor resides in the reality that countries with strong centralized, authoritarian governments, like the former Soviet Union, or today's Russia and China, generally resist transparency and, for that matter, the rule of law more broadly.

Accordingly, TCBMs need to be accompanied by sound and robust space crisis management. Together, they can enhance space security and contribute to the stability and sustainability of the space domain. In this connection, Europe would be wise to shoulder greater allied burden-sharing with the U.S, an instinct that it lacks today. This would strengthen Europe's space security footprint which is, to a large extent, limited to the diplomatic aspects of this security portfolio.

Testing the theoretical argumentation against the facts support the conclusions cited above. As described in Chapter 4, U.S. space assets make for attractive targets for China's strategy of asymmetric warfare. The immense U.S. dependence on space systems fuels this temptation. Although conflict in space would be politically reckless and endangering of life on Earth as we know it, such 'incidents' have a disturbingly high potential of happening, and within the next few years.

Russia and China frequently state their opposition to what they term the "weaponization' of space, but are, by far, the principal sources of the man-made threats to this domain. Emblematic of this inconsistency are the initiatives by Moscow and Beijing to prevent an arms race in outer space (PAROS) and the draft Treaty on Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT), which are now being pursued aggressively by these countries in the UN. Moreover, Russia's "no first use" initiative concerning 'the placement of weapons in space', is being advocated against a backdrop of Moscow and Beijing stepping-up their offensive military space capabilities. In addition, as space assets support terrestrial military operations and enable information support and command and control of forces, today's heightened geopolitical tensions, including in Eastern Europe and the Asia-Pacific region, create the potential for miscalculation and conflict impacting the space domain.

There is little evidence that Cold War arms control TCBMs, although helpful, imposed serious obligations or burdens on the U.S. and the Soviet Union. For example, the ABM Treaty was signed at a time when neither party had the technology to deploy effective missile defenses and therefore did not especially constrain them. Provisions of the treaty were likewise often violated.

In addition, as space technologies are inherently dual-use (that is have both civilian and military applications), it is especially challenging to configure a broad architecture for the governance of space that would cover both commercial and military activities. In an environment of growing tensions among major space powers, TCBMs have the potential to reduce the destabilizing aspects of military competition in space. Accordingly, the goal should be to strengthen existing UN treaties and principles concerning outer space, while urgently reflecting on how best to address the changed space paradigm via robust space crisis management and enforcement/retaliatory measures for serious violations of space behavioral norms.

4. IMPLICATIONS AND OUTLOOK

The landscape of today's space activities is increasingly treacherous because of: 1) an increasing number of countries operating satellites and acquiring launching capabilities; 2) the development of counterspace systems; 3) a growing amount of orbital debris; 4) a congested geostationary orbit; 5) finite availability of the radiofrequency spectrum; and 6) a growing dependence on space services by civilians and militaries worldwide. With the notable exception of the U.S., the global space community has not established serious contingency planning, as prediction, prevention, and crisis management are considerably more difficult to orchestrate in the information age.[34]

In an uncontested environment, control of space (a starting point for the deployment of spacepower) can be achieved merely by the capability to access, and use, the domain according to applicable legal rules.[35] In an increasingly "congested, contested and competitive" space

[34] Jana Robinson, "Space Security Policies and Strategies of States and International Organizations: An Introduction," in *Handbook of Space Security: Policies, Applications and Programs*, ed. Kai-Uwe Schrogl et al. (New York: Springer, 2015), 302.
[35] Everett Carl Dolman, "New Frontiers, Old Realities," *Strategic Studies Quarterly* (Spring 2012): 88-89. http://www.au.af.mil/au/ssq/2012/spring/dolman.pdf

environment[36], however, China and Russia have emerged as the top concern of U.S. national security decision-makers.

China's space program is largely non-transparent and it is difficult to navigate Beijing's organizational and bureaucratic structures involved in space activities.[37] There is no policy line separating China's military and civilian space programs.[38] Although China's civilian space activities are showcased, Beijing is also engaged in a robust counterspace program that remains largely covert. Civilian space applications are also fully integrated into the country's more essential military goals and strategies.[39]

China's space technology is advancing rapidly and, in the near-term (if not presently), will be able to support modern military maneuvers and tactics. China's increased space-related investments have already contributed to its military C^{4}ISR capability.[40] Ashley Tellis, an expert on Asian strategic issues, believes that China's growing ASAT capabilities are part of China's larger strategy to be positioned to confront superior U.S. capabilities.[41] Dean Cheng, another China expert, suggests that the overall military space program promotes China's "综合国家力量，*zonghe guojia liliang*", or "comprehensive national security" and can serve as a potent diplomatic tool. The program is also a valuable new source for science and technology as well as the training of skilled professionals, which can boost China's broader economy.[42]

Like China, Russia understands the value of information in 21st century warfighting. Space-based systems integrating C^{4}ISR are understood to be key to what Russia calls the „information-strike operation" that can disrupt the adversary's troop command and control and weapon control

[36] Robert M. Gates and James R. Clapper, "National Security Space Strategy: Unclassified Summary," Washington DC: U.S. Department of Defense and Office of the Director of National Intelligence (January 2011), https://fas.org/irp/eprint/nsss.pdf
[37] Aliberti, Marco, ed., *When China Goes to the Moon* (New York, Heidelberg, Dordrecht, London: Springer, 2015), 8.
[38] U.S. Government Printing Office, *2008 Report to Congress of the US-China Economic and Security Review Commission* (Washington, DC, 2008), 167, http://origin.www.uscc.gov/sites/default/files/annual_reports/2008-Report-to-Congress-_0.pdf.
[39] Ibid. 160.
[40] Ibid. 167.
[41] Ashley J. Tellis, "China's Space Weapons," *Carnegie Endowment for International Peace* (July 23, 2007), http://carnegieendowment.org/2007/07/23/china-s-space-weapons
[42] "Pandas in Orbit: China's Space Challenge," (presentation at The Heritage Foundation, October 8, 2008, http://www.heritage.org/press/events/ev100808a.cfm).

systems, as well as destroy this information resource.[43] The C[4]ISR are related to Russia's nuclear forces, the foundation of its security.

Russia's military doctrine of 2010 identifies the U.S. and NATO as potential enemies. The main threats include: the impeding of state and military command and control and the disruption of strategic nuclear forces, missile early warning systems, and systems for monitoring of outer space. The focus is on protecting Russia's strategic nuclear forces. Accordingly, Russia has been opposing the U.S. ballistic missile defense (BMD) and voices its self-restraint in the development of ASAT weapons. At the same time, Russia warned that should another nation "weaponize" space, it would respond with countermeasures. [44] Asymmetric responses by the Kremlin would be the logical reaction for a number of reasons, including financial limitations on the development of robust counterspace capabilities.

The U.S. and Europe seek to navigate the issue of the dual-use nature of space technologies (with both non-military and military space applications), as well as the use of commercial space assets for military operations, further blurring the line between strictly civilian or military usage, by efforts to strengthen norms of responsible behavior and establish TCBMs. Russia and China have chosen a different, arms control, path. Although U.S. national policy is not, in principle, against space arms control, it makes clear that the U.S. will only "consider proposals and concepts for arms control measures if they are equitable, effectively verifiable, and enhance the national security of the United States and its allies"[45]. That said, the U.S. maintains that there are a number of fundamental challenges related to space arms control concepts, including verification, scope, and the ability to address the most pressing existing threats.

The U.S. expends major political capital on configuring TCBMs for space activities. Europe, which generally favors inclusive, preemptive space diplomacy – for example, by providing emerging competitors with concrete incentives to help safeguard access to, and use of, space –

[43] Jana Honkova, "The Russian Federation's Approach to Military Space and Its Military Space Capabilities," *The George C. Marshall Institute* (November 2013): 3, http://marshall.org/wp-content/uploads/2013/11/Russian-Space-Nov-13.pdf

[44] Christophe Venet, "Space Security in Russia," in *Handbook of Space Security: Policies, Applications and Programs*, ed. Kai-Uwe Schrogl et al. (New York, Heidelberg, Dordrecht, London: Springer, 2015), 366.

[45] "Using Diplomacy to Advance the Long-Term Sustainability and Security of the Outer Space Environment", remarks by Frank A. Rose at the International Symposium on Ensuring Stable Use of Outer Space: Enhancing Space Security and Resiliency, Tokyo, March 3, 2016, http://www.state.gov/t/avc/rls/253947.htm

believes in the same approach. The European Union continues to promote an International Code of Conduct for Outer Space Activities (the latest version of which is dated 31 March 2014), one that advances behavioral norms to prevent irresponsible behavior. To date, the level of multilateral collaboration in this sphere has been woefully inadequate.

The competitive, and increasingly contested, space environment is not particularly conducive to efforts to establish any arms control measures, rules of the road for space and new forms of cooperation. In short, space is perceived as an ideal arena for demonstrating a nation's pride, independence, and capabilities. Accordingly, the ability of Washington and its allies (e.g., the EU) to be accepted as the "rule-maker" is diminished and often regarded as suspect by those space actors that view space as a sphere of opportunity to enhance their perceived strength and even challenge U.S. primacy. Communication among these actors, and achieving consensus among them, under such circumstances is difficult, if not impossible.[46]

Below are three examples that demonstrate the likelihood of an 'incident', and even conflict, among the U.S., and Russia or China, involving space capabilities

One of the areas of potential conflict could stem from space dependency on cyberspace as space capabilities cannot be employed without cyberspace. For example, an attack on location and timing information from a Global Navigation Satellite System (GNSS) may not be a result of jamming or spoofing of the system itself, but could be the result of the exploitation of the network-accessible systems. Accordingly, even if the GNSS receiver is working properly, the data can be false/compromised.[47]

Another problematic area is radiofrequency interference, both intentional and non-intentional. Despite the international ITU regime, however, "harmful interference" is a rapidly growing problem. Deliberate disruption of radio and TV broadcasts through frequency jamming - an intentionally caused interference - in order to deny access to information, is on the rise in several parts of the world. Unequivocal attribution is often difficult, and existing tools for neutralizing

[46] Jana Robinson and Michael Romancov, "Space Crisis Management: Filling the Gaps," *Space and Defense Journal of the United States Air Force Academy* 6:1 (Fall 2012): 40-41, file:///C:/Users/Jana/Documents/MY%20PUBLICATIONS/SPACE%20and%20DEFENSE%20JOURNAL/Space%20and%20Defense%20Vol%206%20Num%201.pdf

[47] Logan Scott, "Spoofs, Proofs and Jamming," *Inside GNSS* (September/October 2013), http://www.insidegnss.com/node/3183

such interference are limited, if not non-existent. Moreover, the technical ease with which both intentional and unintentional frequency interference can occur will remain a significant space security concern for the foreseeable future.[48]

Geographically, a possible near-term conflict between the U.S. and China involving space assets could be over Taiwan. When China witnessed the U.S. show of force in the 1991 Gulf War (described above) and during the 1996 Taiwan Strait crisis (when the U.S. deployed two aircraft carrier battle groups near Taiwan), Beijing became even more determined to reform its doctrine and technological capabilities of its PLA Air Force (PLAAF).[49]

Part of the changes involved the transition from an air force focused on territorial defense towards an air force capable of carrying out offensive missions, and trying to seize and maintain the initiative in its combat missions. Coercive operations against Taiwan might require the PLAAF to deter or prevent U.S. naval and air forces from intervening in support of Taiwan. In addition, PLA would have to be prepared to resist airstrikes against Chinese forces and potential attacks against China's southeastern coast.[50] Ballistic and cruise missiles supported by space-based reconnaissance could now provide the PLA with a force-multiplier in such a Taiwan conflict scenario.[51]

One might also ask, how plausible is it that certain space assets could be put at risk at a time of heightened tensions in the East or South China Seas? What about incidents of temporary interference with space assets if military conflict further intensifies in Eastern Ukraine? Or what about a future incident in the off-shore oil and gas fields of a likely contested Black Sea? These are among the difficult questions/issues that countries will have to face if they are to engage in

[48] Jana Robinson and Vladimir Silhan, "Securing Outer Space: A Major Global Challenge," *The Science for Population Protection 1* (2012), http://www.population-protection.eu/attachments/040_vol4n1_robinson_silhan_eng.pdf#

[49] Roger Cliff, "Development of PLAAF's Doctrine," in *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities*, ed. Richard Hallion et al. (Washington, DC: National Defense University Press, 2012), 151-152.

[50] Murray Scott Tanner, "The Missions of the People's Liberation Army Air Force," in *The Chinese Air Force: Evolving Concepts, Roles, and Capabilities*, ed. Richard Hallion et al. (Washington, DC: National Defense University Press, 2012), 133.

[51] Mark A. Stokes, "Space, Theater Missiles and Electronic Warfare: Emerging Force Multiples for the PLA Aerospace Campaign," (paper presented at a conference entitled "Chinese Military Affairs: A Conference on the State of the Field", National Defense University, Washington, DC 26-27 October, 2000).

appropriate contingency planning and meaningful diplomatic measures to avoid such negative scenarios.

It is not to say that China and Russia are seeking open conflict, but, as was the case many times in the past, hostilities can be a result of miscalculations and misunderstandings in the environment of heightened geopolitical tensions. To avert major power conflict involving space requires able management of tensions and a deep understanding of diplomatic venues and opportunities (including spelling out the unpleasant consequences of continued belligerent actions). The U.S., and its allies, need is to better understand the Chinese and Russian thinking concerning space stability, strategy and doctrine to bolster domain security.

The sad status of multilateral agreements enhancing space security, China's and Russia's military counterspace build-up, and unsatisfactory bilateral relations between the U.S. and both countries, resemble the scenario postulated by Dolman about the status of space domain politics: "[*Realpolitik*, as the most extreme of the political realist theories that concentrates on the national interest and the cold, calculating central role of raw power in politics] is widely criticized by those who have no power, widely employed by those who do."[52] *Astropolitik* has its roots in now-discredited German school of *Geopolitik*, and is reminiscent of *Realpolitik*. Taking this path would represent a bold, and unprecedented, solution for the U.S. Asserting unrivaled dominance of space could, however, diminish the dangers and uncertainties presented by increasingly assertive Russia and China. Although diplomatically unpalatable, it would represent the most likely way to ensure space stability, but, undoubtedly, with a large expense to the guarantor of this domain – the U.S. Accordingly, a better way forward, at least for the foreseeable future, is to configure comprehensive space crisis management and burden-sharing with American allies.

Presently existing and newly proposed norms, guidelines and TCBMs are being further developed in the international legal framework governing space activities, but are being manipulated by Russia and China to advance their great power status. Accordingly, TCBMs and other diplomatic

[52] Everett C. Dolman. *Astropolitik: Classical Geopolitics in the Space Age* (London and Portland, OR: Frank Cass Publishers, 2002), 156.

tools must be accompanied by expanded contingency planning (read crisis management) if the essential services offered by this domain are to be protected and preserved over the long-term. Like calculations regarding Earth-based conflict, potential adversaries need to know that any attempt to alter the space status quo militarily will result in unacceptably high costs for themselves.

TCBMs, in combination with the prospect of tough-minded allied military and non-military responses against a state or states responsible for a major space incident, represents the most promising way forward for protecting the space environment. Greater integration of space security requirements into broader foreign and security policy objectives and considerations is an important step not only for the U.S., but also Europe, Japan and other like-minded space-faring nations. Space crisis management at an international level should involve the establishment of clear procedures (i.e. rules of engagement), especially communications channels, to avoid miscalculations, escalatory spirals and other damaging eventualities. Although no existing unified model can be applied, such an agreement would prove most valuable, particularly if substantial penalties for violators are incorporated.

The U.S. has the best chance of successfully formulating governance concepts for space behavior on the basis of realistic expectations, operational considerations, and high-level political collaboration. Recognition at the highest levels that the security dimensions of space are growing in complexity and lethality and that China's and Russia's military space programs are designed primarily to compromise and/or defeat U.S. space assets, is essential to a successful outcome with regard to space crisis management. In short, the luxury of romantic, idealistic visions of global space cooperation and harmony are no longer affordable. Instead, allied space security burden-sharing and pre-crisis planning and preparation must be the order of the day.

Identifying the proper architecture for meaningful space security will profoundly affect the destiny of humankind from this point forward. One of the great challenges of the 21st century will be how to safeguard space operations, while encouraging expanded, peaceful cooperation with potential adversaries. Key to this endeavor is the maintenance of clear and unequivocal American space dominance, yielding disruptive efforts by potential adversaries futile and prohibitively costly to them. Any faltering of U.S. political will concerning space security will be tantamount to an engraved invitation to less-responsible space-faring nations to fill the void, including foes of freedom.

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Secure World Foundation www.swfound.org
United Nations Office for Outer Space Affairs www.unoosa.org

U.S.-China Economic and Security Review Commission www.uscc.gov

U.S. Department of State www.state.gov

ANNEX – SATELLITES, SPACE DEBRIS AND LAUNCH SITES OF THE U.S., CHINA AND RUSSIA

As of March 2016, based on information from the database of the Union of Concerned Scientists, there were 1381 active satellites in Earth orbits. From this number, the U.S. owns 568 satellites, Russia 133, and China 177 satellites (see table 1 below)[53].

Satellite Quick Facts *(includes launches through 12/31/15)*			
Total number of operating satellites: 1,381			
United States: 568	Russia: 133	China: 177	Other: 503
LEO: 759	MEO: 92	Elliptical: 37	GEO: 493
Total number of U.S. satellites: 568			
Civil: 15	Commercial: 273	Government: 131	Military: 149

Table 1: Satellites in orbit as of December 2015 (source: Union of Concerned Scientists)

[53] Laura Grego, "Tenth Anniversary Release of USC Satellite Database", *Union of Concerned Scientists* (March 3, 2016), http://allthingsnuclear.org/lgrego/tenth-anniversary-release-of-ucs-satellite-database

The U.S. and Russia together own more than 85% of the debris mass in low-Earth orbit (LEO). China's 2007 ASAT test against its own satellite created the largest amount of debris in a single event in the history of space activities. See Figure 1 below demonstrating that the U.S., Russia and China own the largest amount of debris in LEO.[54]

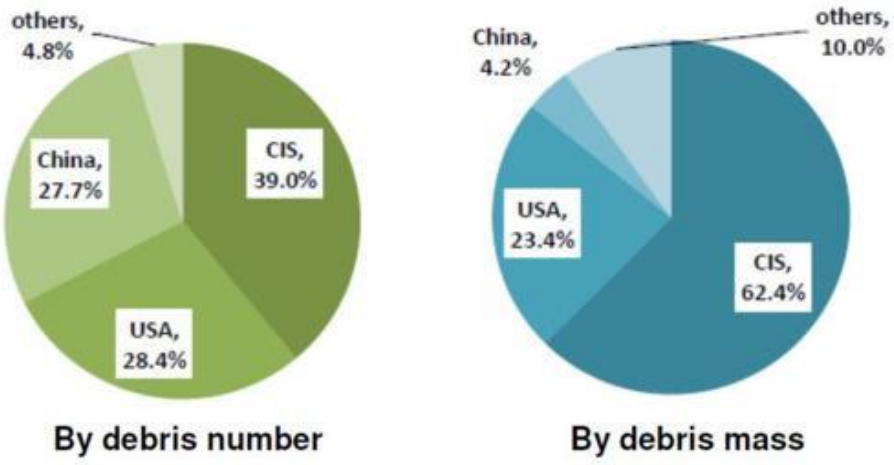

Figure 1: *Debris in low Earth orbit (LEO) by number (left) and by mass (right). CIS represents the Russian Federation (source: Union of Concerned Scientists)*

[54] David Wright, "Who Owns the Most Space Debris?" *Union of Concerned Scientists* (February 24, 2012), http://allthingsnuclear.org/dwright/who-owns-the-most-space-debris-depends-what-you

Continued and independent access to space is a requisite capability for any space power. Below is the list of launch sites of the U.S., China and Russia (table 2).

United States (excludes commercial spaceports)	China	Russia
Cape Canaveral, FL Kennedy Space Center, FL Vandenberg Air Force Base, CA Wallops Island, VA Kwajalein Atoll, Marshall Island Kodiak Launch Complex, Alaska Barking Sands, Pacific Missile Range Facility	Jiuquan Wenchang Xichang Taiyuan	Baikonur Cosmodrome in Kazakhstan Plesetsk Cosmodrome Kapustin Yar Svodobny Cosmodrome Dombarovskiy Vostochny Cosmodrome

Table 2: Space Launch Sites of the U.S., China and Russia (source: spacelaunchreport.com[55]).

[55] Space Launch Report – Pad List – World Launch Sites, updated June 23, 2016, http://www.spacelaunchreport.com/padsites.html