SAILING THE NEW WINE-DARK SEA

SPACE AS A MILITARY AREA OF RESPONSIBILITY

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The designation of a new military area of responsibility is highly significant change, denoting the major structural and functional differences between the current US Space Command and its predecessor, which existed between 1985 and 2002. A few propositions can guide our approach to accomplishing the command's Unified Command Plan responsibilities: the area NOT in the US Space Command AOR is the most special place in the cosmos; the word "global" cannot adequately describe the political/military range of national security considerations; the concept of key terrain must be reimagined in the domain; and the military space AOR has relevance for everyone.

Over the past two years, we have witnessed significant change in the space arena.[1] The United States and its Allies and partners have seen an exciting and almost exponential increase in commercial space while also witnessing their competitors expanding their presence and capability. These changes and our ever-growing dependence on space for everyday life led to the stand up of United States Space Command and United States Space Force. While their statutory responsibilities differ, both organizations focus on the protection and defense of space to ensure free and unfettered access to the domain and continued delivery of space-enabled capabilities to the terrestrial spheres.

The creation and delineation of these organizations mark a significant milestone for the future of human activity in space. Such inflection points, aptly characterized by historian Thomas Cahill as "Hinges of History" in his eponymous series of books, occur relatively infrequently, but always with dramatic effect. Cahill's central thesis is that history is not just linear but rather represents a set of punctuated events that could have taken history (and consequently, the future) in any number of directions. Decades

1. This article is an expansion on remarks delivered by Lieutenant General John Shaw at the Space Warfighter Luncheon, 2021 National Space Symposium, Colorado Springs, CO, https://youtu.be/n6BY-axNklvA. This article proposes two new English language words ("supraglobal" and "downwell"), and two new definitions to two exisitng words ("astrographic" and "upwell"). The authors wish to thank Dr. Andrea Van Nort (USAFA English Department) and Colonel Luke Sauter (USAFA Astronatics Dept Head) for their assistance in the development of these words and their definitions. The authors would also like to offer a special thanks to Mr. Andre Shappell for his invaluable assistance in reviewing the content of this article.

after landing a man on the moon, and after years of remarkable technological advancements inherent in harnessing the benefits of space-based assets, we are again facing changes so dramatic that they will fundamentally alter the geopolitical environment on Earth.

The fourth installment of Cahill's series, *Sailing the Wine-Dark Sea: Why the Greeks Matter*, details the Greeks' contributions to modern society, both good and bad. Cahill writes of Greek influence on art, philosophy, statecraft, culture, literature, architecture, poetry, and drama, among many other influences. He also writes extensively about the Greek influence on the modern way of war.[2] Throughout, Cahill emphasizes the significance of ancient history to events occurring today—an ode to the Greeks and how they built much of the foundation for our twenty-first-century civilization. Curiously, the book provides what could be the perfect model for describing the significance of contemporary inflection points in the development of the space domain.

At some point, were he to become enamored with these recent and fascinating changes in the space arena, Cahill might be compelled to write a new installment in his series, detailing the astonishing developments of the past couple of years as yet another hinge of history. One chapter might focus on China's destruction of their defunct weather satellite in 2007. Another could describe the logic behind the founding of the United States Space Force. With its organize, train, and equip responsibilities, the newly formed service will usher in an era of space-based capabilities focused on ex-geosynchronous operations that would not have proliferated otherwise.

Yet another chapter could focus on the establishment of the new US Space Command. Space operations already naturally serve as global integration activities. Space effects intended for one geographic area are likely to influence, if not directly alter, other areas. So when the entirety of Department of Defense (DOD) space operations, activities, and investments are aligned under the direction of a single combatant command, the capacity for integrating military space with disparate terrestrial military objectives drastically improves.

Were Cahill to ask, we would advise another chapter on a small clause written into the Unified Command Plan at the establishment of US Space Command. While the Unified Command Plan is the overarching document that details the major new mission responsibilities of US Space Command and its commander, one small, seemingly mundane section in it is revolutionary: the plan assigned US Space Command its own military area of responsibility (AOR).

Seemingly a minor detail, the designation of a new AOR is actually a highly significant change, denoting the major structural and functional differences between the current US Space Command and its predecessor, which existed between 1985 and 2002. We are only beginning to understand the potential of this change. A baseline definition and common understanding of what constitutes an AOR is fundamental to understanding why this change is so revolutionary.

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2. Thomas Cahill, *Sailing the Wine-Dark Sea: Why the Greeks Matter* (New York: Random House, 2003).

Doctrinally, an AOR is defined as "the geographical area associated with a combatant command within which a geographic combatant commander has the authority to plan and conduct operations."[3] But the idea of an AOR predates Joint publications significantly. For millennia, AORs have been used as a way for armies, nations, or empires to divide geographic areas of national interest. Identified AORs have certain characteristics and have always been defined by lines on a map. These lines are dictated by a number of factors such as terrain, political context, demographics, and most importantly, threats. Ideally, the sum of all assigned AORs and operations within them meets the strategic objectives of the army, nation, or empire that created them. Areas of operations are not stovepipes, as they are meant to contribute to the attainment of a holistic grand strategy.

Several historical examples of military AORs provide insight into their creation and value. In his account of the pacification of Gaul, Julius Caesar penned probably the most famous AOR in literature. He started this famous work with "Gaul as a whole divided into three parts."[4] In particular, Julius Caesar's justification for *why* Gaul was divided into three parts is of interest: it was fundamentally about terrain, different rule of law, and threats.

Caesar took great care to identify the differences in proximity to Germanic territory, natural territory borders, and the courage of the different factions in each AOR. Together, the combined AORs of Gaul served as a strategic buffer between Rome and the Germanic tribes. In fact, one of the first military objectives Caesar personally recalled in Gaul was to return the Helvetii, a tribe of Gaul, to their native lands to deter the Germanic tribes from crossing the Rhine.[5] By geographically separating Gaul into three areas, Caesar gave his subordinate commanders responsibility for governing each region separately but with a common cause in mind. The most important aspect of Caesar's pacification of Gaul may be the fact that he never mentioned one AOR being more important or influential than the others; they were all equally important to the successful completion of his campaign.

A more modern example familiar to World War II history enthusiasts is the Pacific Theater during that conflict. Though today's singularly defined United States Indo-Pacific Command AOR is the largest US terrestrial geographic theater, the Pacific Theater in World War II was actually divided into two AORs. The Southwestern section consisting predominantly of large land masses was given to General Douglas McArthur, and the section comprising wide areas of open ocean, the Central Pacific, was given to Admiral Chester Nimitz.

While McArthur completed an island-hopping campaign mainly threatened by land-based airpower, Nimitz conducted a naval campaign against a formidable Japanese carrier force and its attendant sea-based airpower. Although this approach was

3. Chairman of the Joint Chiefs of Staff (CJCS), *Doctrine for the Armed Forces of the United States*, Joint Publication-1 (Washington, DC: CJCS, 2017), GL-5.

4. Julius Caesar, *War Commentaries: De Bello Gallico* (London: Dutton, 1953), 11.

5. Caesar, *War Commentaries*, 28.

criticized for disaggregating limited Allied resources, it required the Japanese to disperse their defensive forces.[6] MacArthur focused on isolating key terrain with strong Japanese military presence while securing less-defended islands on his path toward Japan.[7] Between the Battle of the Coral Sea and the Battle of Midway, Nimitz diminished Japanese carrier fleet capabilities, resulting in relative freedom of maneuver for Allied maritime forces in the Pacific.[8] By enabling bombing missions from the Marianas and restricting commerce and resupply through control of the seas surrounding Japan, both AORs proved necessary to achieve victory against the Japanese.

In these past cases as in the present, the 2019 Unified Command Plan assigned an AOR to US Space Command to protect a critical area for national security. This is not unlike the rationale for the division of the Pacific region into two AORs in World War II. But the application of the AOR concept to space presents its own unique set of challenges. Space is significantly different from any previous AOR. For the first time in military history, a military AOR is not defined by geographic lines on a map. In fact, the etymology of the word geographic is Greek and means "drawn on the earth."

In light of this key distinction, a better term defines the US Space Command AOR: astrographic, which means "drawn on the stars."[9] All other combatant commands' AORs are defined by latitude and longitude lines on a map or geographic features. United States European Command is responsible for continental Europe and its proximate bodies of water. The AOR assigned to US Indo-Pacific Command roughly covers the southern Asian continental landmass, southeastern Asian nations and associated waters, and the Indian Ocean.

Defined in a novel manner, US Space Command's AOR is the space beyond 100km of altitude above the mean surface level of the earth—indescribably vast. And while 100km might sound like a random, albeit straightforward round number, it was not an arbitrary selection—100km is the Kármán Line, defined as the point that requires vehicles to exceed actual orbital speed at that altitude in order to generate lift.[10] There may not be a more eloquent or scientifically based possible definition for the boundary between air and space.

As the ramifications of this new AOR for the nation are explored, a few propositions can guide our approach to accomplishing the command's Unified Command Plan responsibilities: (1) the area NOT in the US Space Command AOR is the most special place in the cosmos; (2) the word "global" is increasingly insufficient to fully describe the political/military range of national security considerations; (3) the

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6. Thomas E. Griffith Jr., *MacArthur's Airman: General George C. Kenney and the War in the Southwest Pacific* (Lawrence: University Press of Kansas, 1998), 49.

7. Griffith, *MacArthur's Airman*, 235.

8. Craig L. Simmons, *The Battle of Midway* (New York: Oxford University Press, 2011), 184–85.

9. This represents a new definition of astrographic developed in part by the authors. It is an adjective meaning drawn on the star or an area defined by boundaries or features in space.

10. Eric Betz, "The Kármán Line: Where Does Space Begin?," *Astronomy*, March 5, 2021, https://astronomy.com/.

concept of key terrain must be reimagined in the domain; and (4) the military space AOR has relevance for everyone.

Proposition Alpha Prime

The area NOT in the US Space Command area of responsibility is the most special place in the cosmos.

The place in the universe not covered by the space AOR, that is, 100km of altitude and down—approximately 1x10-24 percent of the known universe—is the most special place in the cosmos and will remain so for millennia to come.[11] We do not explore space simply for the sake of exploring space; we do it for the benefit of humankind. And those humans live on Earth. It is critical to remember this fact. Human activity in space starts below 100km, and these operations and efforts certainly apply to US Space Command.

The command must ensure it delivers capabilities to Joint warfighters outside the space AOR and to human society at large. Earth is where every human was born and where most humans have remained except for about 600 individuals lucky enough to spend time in space (most just slightly above the Kármán Line). Proposition Alpha Prime will hold firm as humans continue to explore, even when spacefaring nations begin to visit other planets.

Proposition Two

The word "global" is increasingly insufficient to fully describe the political/military range of national security considerations.

The Department of Defense has diligently endeavored in recent years to transcend regional thinking. When it comes to current operations, military professionals strive to focus on global competition and globally integrated operations. But viewing operations on Earth without accounting for the vast AOR assigned to US Space Command artificially constrains the perspective and considerations available to decision makers to accomplish a desired national security objective.

How might the Department remedy this? About 15–20 years ago, the word "supranational" was introduced to discuss threats that superseded the borders of nation-states. Given the command's domain and responsibilities, a new term may be warranted: supraglobal, or those things that are relevant to military or political matters that encompass the globe and relevant activities in the space beyond it.

Though global can mean applied to the whole of something, the term is more commonly used in military circles to distinguish the needs of the entire Joint/combined Force from those that are regionally focused.[12] The English language does not have a

11. Calculated using the isotropy theory assumption that the universe is expanding in all directions at the same rate and recent estimations of current expansion radius.

12. *Merriam-Webster Online*, s.v. "global," accessed December 22, 2021, https://www.merriam-webster.com/.

word that adequately conveys a sense of that which lies beyond the global terrain, but supraglobal could be a remedy. This term integrates the Department's current approach to globally integrated operations with the nascent idea of treating the space AOR as an operational domain linked to all of the terrestrial domains.

The concept of an AOR is actually quite new in the military space world. Prior to the establishment of the new US Space Command, United States Strategic Command had responsibility for space operations, but the AOR was not defined, nor was it defined for the original US Space Command. Military space missions under US Strategic Command were treated doctrinally as a functional combatant command and primarily provided transregional supporting capabilities to geographic combatant commands.

Since the new US Space Command has been given an AOR, the space domain can be defined as an operational domain with potential threats. Those threats are increasing, our reliance on space is expanding, and this dependence will not change anytime soon. The nature of military space requires a change of thought. Much remains to learn and understand: What is the key terrain of the domain? What are the maneuvers, needs, challenges, and potential realities of this domain? These questions lead to the next proposition.

Proposition Three

The concept of key terrain must be reimagined in the space domain.

Key terrain is a concept as old as warfare and requires nuanced conceptual thinking in different domains. In doctrine, key terrain is defined as "any locality, or area, the seizure or retention of which affords a marked advantage to either combatant."[13] But such advantages are gained differently from one domain to another.

Because of vast elevation differences in the land domain, taking the high ground delivered decisive advantage for one's forces. In traditional naval operations, such elevation differences do not exist, and key terrain was more influenced by the tides, currents, and maritime chokepoints. When airpower became a military domain in the early twentieth century, key terrain for the air was determined by the range forces could travel, or maintain lift, versus explicit terrain features. What does this mean for the space domain? A strong argument can be made that the natural differences in the physical environments between space operations and terrestrial operations are greater than differences in operations between the terrestrial domains.

In space, the energy required for movement and maneuver differs from that of terrestrial operations; moving toward and away from the earth is not as simple as moving downhill and uphill, respectively. For example, it takes essentially the same amount of energy to move from circular geosynchronous orbit (GEO) to circular medium Earth orbit (MEO) as it takes to move from circular MEO to circular GEO, which is very different from experiences such as hiking up and down a mountain on Earth.

13. Chairman of the Joint Chiefs of Staff (CJCS), *DoD Dictionary of Military and Associated Terms*, s.v. "key terrain," (Washington, DC: CJCS, November 2021), https://www.jcs.mil/.

Using human intuition to describe such movements in space can be contrary to physical reality. When discussing China destroying its defunct weather satellite in 2007 or Russia's direct-ascent antisatellite test in 2021, the inference most people make, based on the popular description of those activities as "shooting a satellite down," is not accurate. If either nation had in fact "shot it down," the world would not be having to cope with thousands of pieces of debris still in orbit from those events. "Shooting something down" in space is not an accurate description. What actually occurred is significantly worse.

So how can maneuver, and by extension key terrain, in space be better visualized? Terrain in the space domain is best described by those beautiful Einsteinian curves in spacetime known as gravity wells. Generally speaking, a gravity well describes the amount of force celestial bodies exert on objects in space.[14]

The space domain is home to many gravity wells. In practical terms, space operations planners must account for movement within the Earth gravity well, the combined Earth and moon gravity well, and within the sun's gravity well. Similar to maritime reliance on tides and currents before the invention of the steam engine, the majority of movement in space is largely dictated by gravitational forces and initial momentum (at least until another offset in space energy and propulsion is realized). As such, positions that provide advantage, or key terrain, will remain connected to these natural forces due to limited energy alternatives. For the foreseeable future, military, civil, and commercial actors in space will be required to plan and budget for future space operations with this constraint in mind.

A helpful way to describe the connection of gravitational energy to movement and maneuver between orbits is to use the terms "upwell" and "downwell," as either verbs or adjectives. Upwell can be defined as a verb (to increase orbital energy within a gravity well), an adverb (in the direction of increased orbital energy within a gravity well), or as an adjective (in a position of increased orbital energy within a gravity well). Downwell can be also be defined as a verb (to decrease orbital energy within a gravity well), an adverb (in the direction of decreased orbital energy within a gravity well), and as an adjective (in a position of decreased orbital energy within a gravity well).

Adding the definition "increasing orbital energy within a gravity well" to "upwell" is sufficient, but "downwell," or "decreasing orbital energy within a gravity well," is not a currently recognized word in the English language. Still, these proposed words and definitions would better capture the unique relationship of movement and energy in the space domain.

By connecting movement in space with the energy necessary to accomplish it, operations in the space domain would be differentiated from the common understanding of movement in the land, sea, and air domains. Such separation is necessary to adequately identify and communicate the unique aspects of space movement and maneuver and the resulting key terrain. As we increase the understanding of domain

14. Northwestern University, "Space Environment: What Is a Gravity Well?," Northwestern University (website), https://www.qrg.northwestern.edu/.

specifics, a wider range of actors will acknowledge the complexity of operating in the US Space Command AOR and its value to the nation and broader international community.

Proposition Four

The military space area of responsibility has relevance for everyone.

The ways in which US Space Command, with the help of its service components, operates within the AOR is relevant to all activity in space. At a baseline level, the AOR directly enhances Joint and combined operations across the globe and beyond. Indispensable capabilities such as missile warning; position, navigation, and timing; environmental monitoring; and satellite communications allow forward-deployed forces to carry out missions with lightning precision across multiple domains. Space-based nuclear command, control, and communications systems are bedrocks of the nuclear deterrent our nation relies on to prevent catastrophic attacks on the homeland. Domain awareness yields a thorough understanding of actions and intent in the AOR to minimize unintended consequences or miscommunication with other spacefaring actors.

Competitors see the military benefits of US space-based capabilities and are rapidly moving to close the advantage gap. Over the last decade and a half, the United States, its Allies, and partners observed as weapons testing in the domain created challenges for responsible space activity and freedom of action in, from, and to space. With a designated AOR, however, US national leadership enabled unity of effort in space to deter aggression and deliver superior space combat power in the event deterrence fails. United States Space Command will protect and defend this AOR and hopes potential malign actors are watching. And while relevance of the command's AOR to military operations might be considered a given, its benefits extend much further in scope.

The general population of Earth benefits as well, even if most people may not be aware of it. Nearly every person across the planet is an end user of space capabilities, and day-to-day life activities are protected by the formation of the AOR. Since its inception, the global positioning system (GPS) has enabled over $1.4 trillion in US economic benefits.[15]

Whenever people visit a gas station and pay at the pump or use an ATM, they are using space. Seafaring maritime traffic utilizes position, navigation, and timing data to deliver goods from overseas ports to local stores and retailers. Farmers use space assets to optimize crop outputs, lowering produce costs at the grocery store, and people are able to near-instantaneously converse across the planet due to satellite communications. Organizing US military space capabilities to work together in the AOR allows the Joint Force to identify threat indicators and proactively protect myriad GPS quality-of-life enhancers.

15. National Oceanic and Atmospheric Administration, Office of Space Commerce, *DOC Study on Economic Benefits of GPS*, Office of Space Commerce (website), https://www.space.commerce.gov/.

Similarly, members of the commercial space industry should be interested in the formation of the US Space Command AOR. In 2020, the global space economy increased to $447 billion with approximately 80 percent of the total due to commercial endeavors.[16] By some estimates, another 17,000 satellites will be launched by 2030, most with commercial origins.[17] With a myriad of new commercial space assets projected in the near future, the command's ability to accurately depict the space operating environment and avoid debris-causing collisions will be foundational in creating predictable conditions for sustained business growth in the domain.

Throughout history, maritime merchant traffic operated with more confidence knowing a navy was close by to keep things safe and transparent. Similar conditions must be fostered for safeguarding space commerce. Currently, DOD space assets provide early warning of potential collisions and notify affected commercial entities, reducing the chance of orbital debris or mission failure. By assigning all relevant terrestrial and on-orbit space domain awareness sensors to US Space Command to protect the AOR, the Department of Defense has optimized detection capabilities that protect one of our nation's biggest advantages—commercial-sector innovation.

Finally, civil organizations like NASA benefit from having a single DOD organization responsible for ensuring safety, security, and stability in space. The Artemis Program will carry astronauts to the moon for the first time in 55 years, followed by an eventual crewed mission to Mars. Originally signed in 2020, the NASA-sponsored Artemis Accords provide a common framework to usher in a new era of space exploration. Signatories affirmed several items conducive to cooperative space exploration including shared access to scientific data gained, the pursuit of interoperable space technologies, and transparent notification for areas of harmful interference.[18]

As civil organizations from the international community expand human presence further into the AOR in the name of peaceful exploration, the need to recover astronauts in distress will become more complex and far-reaching. Currently, US Space Command is charged with human space-flight support and actively supports launch and recovery operations of US-based crewed spaceflight. As humankind continues to travel further out from the most special place in the cosmos, the command will be ready to execute its responsibility for the human space-flight support mission.

Conclusion

Defining US Space Command's AOR has already had a profound impact on the way the United States, its Allies, and partners conduct operations and respond to

16. Space Foundation Editorial Team, "Global Space Economy Rose to $447B in 2020, Continuing Five-Year Growth," Space Foundation (website), July 15, 2021, https://www.spacefoundation.org/.

17. *Satellite Pro Middle East*, "17,000 Satellites To Be Built and Launched by 2030: Euroconsult," *Satellite Pro Middle East* (website), December 7, 2021, https://satelliteprome.com/.

18. The Artemis Accords: Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets, and Asteroids for Peaceful Purposes, US, Australia, Canada, Italy, Japan, Luxembourg, UAE, UK, October 13, 2020, US National Aeronautics and Space Administration.

aggression and threats in space. In addition to the increased integration a space AOR will have on terrestrial operations, this development promises untold hinges of history that will be influenced by the understanding and execution of space operations. The four propositions posed here are just a glimpse of considerations necessary to adequately plan for the future of the space AOR.

Earth remains the most precious part of the universe. As humankind continues to expand into the cosmos, its actions must be focused on the preservation of this tenet. By thinking in a supraglobal fashion, decision makers will consider a more complete range of possibilities for identifying threats to military objectives and for appropriate astrographic as well as geographic solutions.

But before such solutions can be realized, leaders must understand how activities in the AOR differ from activities in the terrestrial domains. Reimagining AOR core principles such as key terrain will help spacefaring nations better analyze current capabilities and future needs and develop appropriate doctrine in response. This approach optimizes US Space Command's ability to protect and defend the capabilities originating from an AOR that holds worldwide relevance. When looking back in five to ten years from now, it will be even more apparent how our times contributed to defining a new "hinge of history," and how how the establishment of the 100km and above AOR became our best response to that inflection point as we continue to sail our new wine-dark sea. *Æ*

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