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THESIS

**ENHANCING NAVAL OPERATIONS THROUGH SPACE
COOPERATION: THE ROLE OF ALLIES**

by

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THE ROLE OF ALLIES**

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Submitted in partial fulfillment of the
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ABSTRACT

Since 1957, space has been a significant domain of great power competition, generating soft power and providing pronounced military benefits. As the United States enters an era of renewed great power competition with peer adversaries, the U.S. Navy, operating as a forward presence, faces increased challenges from Russia and China. This thesis investigates possible allied space coalition structures and how space cooperation can be leveraged as a force multiplier to enhance naval operations. Two case studies are featured as a means of evaluating current U.S. allies, their space capabilities, policies, and histories. Germany, France, and the UK are examined in the context of challenges from Russia in the Mediterranean and Arctic, and Japan, Australia, and South Korea are considered relative to the operational challenges in the South China Sea and a Taiwan contingency resulting from the rise of China. The military space programs of Europe are found to be much more developed and interconnected than the more nascent Indo-Pacific military space programs, which remain separated as a result of historical tensions and Cold War–era bilateral cooperation structures. Ultimately, this thesis determines that a U.S.-led space coalition should break from past bilateral or regional alliance structures in favor of a global space coalition to best leverage the benefits of burden sharing, deterrence, mission assurance, and increased capacity to support global maritime operations.

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LIST OF ACRONYMS AND ABBREVIATIONS

A2/AD	Anti Access/Area Denial
ADF	Australian Defence Force
AFB	Air Force base
AIES	Austrian Institute for European and Security Policy
AO	area of operations
AOR	area of operations
ASAT	Anti-Satellite Weapon
ASEAN	Association of Southeast Asian Nations
ASOC	Air and Space Operations Center
ASW	anti-submarine warfare
AUS	Australia
BLOS	beyond line of sight
BRI	Belt and Road Initiative
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAATSA	Countering America's Adversaries Through Sanctions Act
CDCM	Coastal Defense Cruise Missile
CDO	contested, degraded, and operationally limited
CERES	Capacité de Renseignement d'origine Electromagnétique Spatiale
CNES	Centre National d'Etudes Spatiales
CNO	Chief of Naval Operations
COCOM	combatant command (command authority)
COP	common operational picture
CSE	Commandement de l'Espace
CSO	Composante Spatiale Optique
DBB	Defense Business Board
DGA	Directorate General of Armament
DHS	Department of Homeland Security
DIA	Defense Intelligence Agency
DMSP	Defense Meteorological Satellite Program

DOD	Department of Defense
DRM	Direction du Renseignement Militaire
DSCS	Defense Satellite Communication Satellite
EEZ	Exclusive Economic Zone
EHF	extremely high frequency
ELDO	European Launcher Development Organization
ELINT	electronic intelligence
ELISA	Electronic Intelligence by Satellite
EO	earth observation
EO/IR	Electro-Optical/Infra-Red
ESA	European Space Agency
E-SGA	Europäisierung der satellitengestützten Aufklärung
ESS	Evolved Strategic Satellite Communications
EU	European Union
EU	European Union
EW	Electronic Warfare
FOC	full operational capability
FONOPS	Freedom of Navigation Operations
GBS	Global Broadcast System
GEO	Geostationary
GMP	global maritime partnerships
GNoN	Global Network of Navies
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite Program
GPS	Global Positioning System
GTS	Global Telecommunication System
HA/DR	humanitarian assistance and disaster relief
HF	high frequency
HF/DF	high frequency direction finding
HTS	high-throughput satellite
IGS	Information Gathering Satellite
IP	internet protocol

IR	infrared
ISCS	International Space Cooperation Strategy
ISR	Intelligence, Surveillance and Reconnaissance
ITAR	International Traffic in Arms Regulations
JADC2	Joint All Domain Command and Control
JAXA	Japan Aerospace Exploration Agency
JMSDF	Japan Maritime Self Defense Force
JP	joint publication
KARI	Korea Aerospace Research Institute
KASS	Korean Augmentation Satellite System
KSLV	Korean Space Launch Vehicle
LANDSAT	Land Remote Sensing Satellite
LEO	Low Earth Orbit
LOE	Line of Effort
MDA	maritime domain awareness
METOC	meteorological and oceanographic
MILSAT	military satellite
MILSATCOM	military satellite communications
MOD	Ministry of Defense
MOU	memorandum of understanding
MPA	maritime patrol aircraft
MSO	maritime security operations
MUSIS	multinational space-based imaging system
NATO	North Atlantic Treaty Organization
NAVO	Naval Oceanographic Office
NM	nautical mile
NMDAP	National Maritime Domain Awareness Plan
NOAA	National Oceanic and Atmospheric Administration
NPS	Naval Postgraduate School
NSR	North Sea Route
NSS	National Security Strategy
OE	operational environment

OSG	Operation Sea Guardian
PLA	People’s Liberation Army
PLAN	People’s Liberation Army-Navy
PNT	Positioning, Navigation and Timing
PRF	pulse repetition frequency
PTS	Protected Tactical Satellite Communications
QZSS	Quasi-Zenith Satellite System
RAAF	Royal Australian Airforce
RAF	Royal Airforce
RAN	Royal Australian Navy
ROK	Republic of Korea
SAR	synthetic aperture radar
SATCOM	Satellite Communication
SBAS	Satellite-Based Augmentation System
SCS	South China Sea
SDF	self-defense force
SHF	super-high frequency
SIGINT	signals intelligence
SPOT	Satellite pour l’Observation de la Terre
SSA	Space Situational Awareness
SSF	Strategic Support Force
TRA	Taiwan Relations Act
U.S.	United States of America
UHF	ultrahigh frequency
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNHCR	United Nations High Commissioner for Refugees
UNSCR	United Nations Security Council resolution
USCG	United States Coast Guard
USGS	United States Geological Survey
USN	United States Navy

USNI	United States Naval Institute
USS	United States Ship
WGS	Wideband Global Satellite Communications

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I. INTRODUCTION

In an era of renewed great power competition, the United States is moving away from the global war on terror and facing near peer competition with China and Russia. It is under this context that we need to evaluate the role of space. How can our traditional alliances and networks be strengthened through allied space cooperation to meet the challenges of the day? Can space alliances be used as a force multiplier?

This thesis tackles the central question: What is the most effective way to structure a space coalition with existing allies to best enhance naval operations? American space strategy exhibited a major shift toward cooperation in 2010 with President Obama's release of his new *National Space Policy*.¹ Cooperation and interoperability with allies in space was reinforced in 2011 with the release of the *National Security Space Policy*, affirming the fundamental nature of space capabilities to U.S. national security.² Allied space cooperation has an extremely broad application to intelligence agencies, and across the military at large. That challenge, however, is beyond the scope of this work. This thesis attempts a more modest task of proposing key elements for building an allied space network with the intent to enhance the effectiveness of naval operations. The *2018 Design for Maintaining Maritime Superiority 2.0* calls for extended networks of allies and regional partners to leverage capabilities and strengthen global maritime awareness.³ At the time of this writing, the Tri-Service Maritime Strategy has been recently released, to address the threat from China and Russia. It maintains the need for "unity of effort" with allies, which

¹ White House, *National Space Policy of the United States of America* (Washington, DC: White House, 2010), https://obamawhitehouse.archives.gov/sites/default/files/national_space_policy_6-28-10.pdf.

² Department of Defense and Office of the Director of National Intelligence, *National Security Space Strategy of the United States of America* (Washington, DC: Department of Defense, 2011), 6, https://www.dni.gov/files/documents/Newsroom/Reports%20and%20Pubs/2011_nationalsecurityspacestrategy.pdf.

³ Chief of Naval Operations, *A Design for Maintaining Maritime Superiority 2.0* (Washington, DC: Chief of Naval Operations, 2018), <https://www.documentcloud.org/documents/5633091-A-Design-for-Maintaining-Maritime-Superiority.html>.

generates power to “modify behavior in the maritime domain.”⁴ In this framework, space cooperation can be viewed as any coordinated effort between allies to share costs, equipment, operations, or information pertaining to space systems or derived from them.

Ultimately, this thesis explores allied space cooperation in two critical regions, Europe and the Indo-Pacific, evaluating possible integration with naval partners. How could high-end interoperability through an allied space network enhance the Navy’s strategic efforts and help achieve regional security? Within this analysis, the current U.S. alliance structure and possible impacts of enhanced cooperation on naval operations are evaluated. The choice to focus on Europe and the Indo-Pacific regions is made to view the role of space cooperation and coalitions through the lens of renewed great power competition with Russia and China.

A. SIGNIFICANCE OF THE RESEARCH QUESTION

In 1957, the Union of Soviet Socialist Republics (USSR) launched *Sputnik 1*, the first artificial satellite, into low earth orbit (LEO), prompting the United States to follow suit, launching *Explorer 1* in 1958. This began what would become a dramatic space race and an era of increasingly advanced space and satellite technology, both civil and military. The question of how to engage with space has long been tied to the notion of national security and defending military, political and economic interests. Access to space also grants countries a kind of soft power derived from international prestige, as well as technological benefits. It is no great leap connecting space to international geopolitical competition. Indeed, since 1957, competition in one form or another has driven the space race.

From the days of the Cold War space race to the modern era, space has always been intricately tied to the political tensions of the day. Emerging in the *2017 National Security Strategy*, strategic thinking in America has now shifted to that of an era of renewed great

⁴ Department of the Navy, United States Coast Guard, and United States Marine Corps, *Advantage at Sea: Prevailing with Integrated All-Domain Naval Power* (Washington, DC, 2020), 10, <https://media.defense.gov/2020/Dec/17/2002553481/-1/-1/0/TRISERVICESTRATEGY.PDF/TRISERVICESTRATEGY.PDF>.

power competition.⁵ Seeking to expand its influence and reemerge as a great power, the Russian Federation, through its military and political actions, has undermined international norms and violated agreements, including: the UN Charter, Helsinki Accords, Russia-NATO Founding Act, Budapest Memorandum, and Intermediate-Range Nuclear Forces Treaty—thereby destabilizing regional security.⁶ The United States and its NATO allies and partners throughout Europe are challenged with the strategic implications of these expanded military operations and efforts to upset the established world order.

Similarly, in the east, China, a once agrarian empire, has emerged as an industrial and economic power seeking to exert its influence beyond its borders. China's emergence as a great power threatens to unhinge the current world order, as it fails to comply with established international law. A prominent maritime nation in the Indo-Pacific, China had ratified the United Nations Convention on the Law of the Sea (UNCLOS) on 7 June 1996, as one of the 168 signatories. The U.S. Naval War College Stockton Center for International Law identified in a 2021 report, however, that China had immediately broken from the Convention starting in 1996.⁷ It declared excessive maritime baselines, unlawfully claiming all territory within the historic Nine-Dash Line (9DL), promoted illegal requirements for Innocent Passage, and violated the privileges afforded by exclusive economic zones (EEZ), both domestically and within the waters of regional neighbors.⁸ In 2016, the Hague Tribunal, unanimously found China to be in violation of UNCLOS.⁹ Despite the tribunal and international outcry, China has maintained its course, continuing to upset the international rules-based order and the geopolitical system through its economic policies and maritime actions.

⁵ White House, *National Security Strategy of the United States of America* (Washington, DC: White House, 2017), 25, <https://www.hsdl.org/?abstract&did=806478>.

⁶ Joint Chiefs of Staff, *National Military Strategy of the United States of America* (Washington, DC: Joint Chiefs of Staff, 2015), 2, <https://doi.org/10.21236/ADA619156>.

⁷ Office of the Staff Judge Advocate, "China's Excessive Maritime Claims," *International Law Studies* 97, no. 1 (January 2, 2021): 19–23, <https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=2941&context=ils>.

⁸ Office of the Staff Judge Advocate, 19–23.

⁹ Office of the Staff Judge Advocate, 23.

The U.S. Navy has long been integral to U.S. foreign policy, working hand-in-hand with the Department of State, as the “forward presence service” used to advance national interests abroad.¹⁰ Summarily, in an era of renewed great power competition, the Navy finds itself central to efforts at diplomacy and deterrence in the face of these rising revisionist powers. Given the undeniable importance of space, and its role in national security will be integral to the challenges the U.S. Navy faces in Europe and the Indo-Pacific. The use of counterspace capabilities is written into both Chinese and Russian doctrine, to reduce U.S., allied, and partner military effectiveness, as well as to deter and counter intervention in regional military conflict.¹¹ For the U.S. Navy to maintain its effectiveness at sea as a strategic force, the continuity and resilience of space-based assets is essential. Norman Freedman writes in *Seapower and Space*: “The surface ships are effective because they have access to space resources, particularly to the fruits of national sensors.”¹² Furthermore, he posits that “information gathered by multiple remote sensors, fused and overlaid, and distributed reliably by satellite is the key to future victory at sea.”¹³ Without an effective allied space network to build resiliency and continuity of access, the United States runs the risk of removing the Navy from the fight. Having a well-structured allied space network and securing our access to space-based capabilities may be essential to great power competition in the coming decades.

B. LITERATURE REVIEW

Strategic thinking in the United States underwent a major shift in 2010, at least as far as space and international security was concerned. Emerging from a much more unilateral and aggressive era of space policy rooted in the ideals of the Cold War, the *2010 National Space Policy* released by President Obama set forth the conditions for an entirely

¹⁰ Michael W. Coulter, “State and Navy: Partnership in Diplomacy,” *Proceedings* 133, no. 7 (July 10, 2007): 44–48.

¹¹ Department of Defense, *Defense Space Strategy Summary* (Washington, DC: Department of Defense, 2020), 3, https://media.defense.gov/2020/Jun/17/2002317391/-1/-1/1/2020_DEFENSE_SPACE_STRATEGY_SUMMARY.PDF.

¹² Norman Friedman, *Seapower and Space: From the Dawn of the Missile Age to Net-Centric Warfare* (Annapolis, MD: Naval Institute Press, 2000), 303.

¹³ Friedman, 311.

different view on international space relations.¹⁴ This document emphasized cooperative measures rather than the space nationalist view of the Bush administration's *2006 National Space Policy*, which emphasized the need for "freedom of action in space."¹⁵ The Obama administration in 2011 released the first *National Security Space Strategy*. It emphasized that "The United States will lead in building coalitions of like-minded space-faring nations" and "we will explore the development of combined space doctrine ... and enable the collaborative sharing of space capabilities in crisis and conflict."¹⁶ These two documents released within a year of each other shifted the focus of American strategic thinking down the path of allied space cooperation.

The Trump administration was slow to release its *National Space Policy*. In December 2020, one month before leaving office, a detailed policy for American space interests was released. Specific to allied cooperation, the plan encouraged the Department of Defense to "Augment United States capabilities by leveraging existing and planned space capabilities of allies and partners."¹⁷ This vision was in line with the previous administration and allowed for continuity of effort in U.S. strategic efforts at engaging allies in space.

The Defense Department has built on the broader space strategy and specified its own priorities for the department. In 2017 the *Department of Defense International Space Cooperation Strategy* (ISCS) was enacted citing "international cooperation as a central element of the larger U.S. space strategy."¹⁸ The stated purpose of the ISCS was an approach to leverage the capabilities of U.S. allies and partners to expand "interoperability,

¹⁴ White House, *National Space Policy of the United States of America*, 2010.

¹⁵ James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests, Third Edition* (Stanford: Stanford University Press, 2019), 300, <http://www.sup.org/books/title/?id=31357>.

¹⁶ Department of Defense and Office of the Director of National Intelligence, *National Security Space Strategy of the United States of America*, 9.

¹⁷ White House, *National Space Policy of the United States of America* (Washington, DC: White House, 2020), <https://www.federalregister.gov/documents/2020/12/16/2020-27892/the-national-space-policy>.

¹⁸ Department of Defense, *DOD International Space Cooperation Strategy* (Washington, DC: Department of Defense, 2017), 1, <https://www.hsdl.org/?abstract&did=805231>.

sustainability, mission assurance, and assured access to critical capabilities in crisis and contingency operations.”¹⁹ The DOD, in June 2020, expounded upon its policy in the *Defense Space Strategy*, noting the international growth in space activities, particularly among our allies, and identifying these developments as “novel opportunities to increase defense collaboration and cooperation.”²⁰ This document is the first to directly make the connection between allied space cooperation and the return to great power competition with Russia and China. Naval strategic thinking has long been in favor of allied and joint operations. However, it was not until the newly released Tri-Service Maritime Strategy, *Advantage at Sea*, that the Navy began addressing how to leverage allied and partner space capabilities to be used as a force multiplier, while emphasizing allied networks to “uphold global maritime security.”²¹

In the academic literature, there is a relative consensus that the newly emerged concept of allied space networks is beneficial for space security. However there remains no generally agreed upon idea of how an allied space network should be structured or where the priorities should lie when considering obstacles to advancement of cooperative efforts. The dominant view observed in the literature is one of global networks. Although, many of the writings on the subject do not expressly emphasize this structure, their uninhibited use of the phrasing “allies” and discussion of the basis of what these systems should look like lends itself toward a global system of allied cooperation.

James Clay Moltz was one of the earliest voices supporting allied space networks, advocating for a globally structured, U.S.-led system. Writing in 2011, he stated “an allied approach to space may represent the best short-term route to enhanced U.S. and allied space security, while potentially offering benefits to the global community of space users as well.”²² Building on Moltz’s work, Capt. (Ret) Alan Scott, in a paper supplementing a

¹⁹ Department of Defense, 1–2.

²⁰ Department of Defense, *Defense Space Strategy Summary*, 1.

²¹ Department of the Navy, United States Coast Guard, and United States Marine Corps, *Advantage at Sea: Prevailing with Integrated All-Domain Naval Power*, 13.

²² James Clay Moltz, “Coalitions in Space: Where Networks Are Power,” *Space and Defense*, Vol. 5, no. 1 (Summer 2011): 7.

Defense Threat Reduction Agency study, endeavored to provide the basis of a framework for how these architectures could be structured, addressing cooperation in Space Situational Awareness (SSA) and Intelligence, Surveillance, and Reconnaissance (ISR) collaboration. He proposed that the U.S. leverage capabilities of the European Space Agency (ESA) and Japan, even going so far as suggest one day possible integration with a then-more-friendly Russia. Scott surmised that despite the clear benefits for further international cooperation in space, there are major hurdles that need to be addressed, such as classification issues limiting data sharing and the interoperability of dissemination systems.²³

The Aerospace Corporation, Center for Space Policy and Strategy conducted a study in 2020 on defense space partnerships. They found many of the same hurdles raised by Scott, acknowledging the more technical difficulties and furthermore addressing specific organizational challenges. Their report authored by Robert S. Wilson, Colleen Stover, and Steven R. Jordan Tomaszewski argues that navigating the “myriad of organizations” for defense space partnerships is a challenge for allies.²⁴ Additionally, where the United States has made progress toward cooperative efforts in space, it has failed to fully leverage allied capabilities. They make the point that these partnerships themselves are the goal, proposing that an allied space network should be viewed not as a “transactional benefit but as a strategic objective itself.”²⁵ In the *Handbook of Space Security*, Jana Robinson writes on the importance of allies for space security and bringing together the space security communities of Europe and Japan. To address the issue, she conducted case studies of U.S. cooperation with Europe and Japan, describing current allied space

²³ Alan D. Scott, *Coalition Building in Space: Initial Technical Considerations and Potential Implementation Strategies*, OSRD 2011 023 (Monterey, CA: Naval Postgraduate School, 2011), <https://www.hsdl.org/?view&did=716210>.

²⁴ Robert S. Wilson, Colleen Stover, and Steven R. Jordan Tomaszewski, *Defense Space Partnerships: A Strategic Priority* (El Segundo, CA: Aerospace Corporation, Center for Space Policy and Strategy, 2020), 5, https://aerospace.org/sites/default/files/2020-09/Wilson_DefensePartnerships_20200916.pdf.

²⁵ Wilson, Stover, and Jordan Tomaszewski, 7.

cooperation as still “in a relatively nascent stage.”²⁶ Robinson argues that the most successful allied space structure will be one “where mutually reinforcing collaboration exceeds the benefits of competition.”²⁷

In his journal article for the February 2021 edition of *Space Policy*, Gentoku Toyoma, presents a different perspective on space cooperation. He proposes three new conceptual obstacles to a global coalition: the culture of secrecy, the pace of development, and concerns of entrapment. The pace of development, specifically, he cites should favor “unilateral efforts due to the lengthy negotiations and coordination issues” required for a global alliance structure.²⁸ However, he ultimately concludes that the United States should cooperate in space security and that, is “inherently global in nature,” which will help “realize the U.S. goals of resilience and reconstitution.”²⁹

Finally, an NPS graduate thesis in 2018 directly tackled the question of how the United States can benefit from coalition operations in space. While applicable to question of allied coalitions overall, it should be noted that his work was not specifically addressing naval operations. Maj. Robert H. Manuel conducted a case study analysis of three of the United States closest allies: Australia, France, and Japan. He detailed the DOD’s history of collaboration, and any political or cultural concerns that have arisen to strain or streamline these interactions. His work found that despite some success in military space cooperation, the United States and DOD must continue the work toward collaboration to gain “an asymmetric military advantage over its near-peer competitors, Russia and China, for whom such collaboration appears highly unlikely.”³⁰

²⁶ Jana Robinson, “U.S. Space Security and Allied Outreach,” in *Handbook of Space Security: Policies, Applications and Programs*, ed. Kai-Uwe Schrogl et al. (New York, NY: Springer, 2015), 329, https://doi.org/10.1007/978-1-4614-2029-3_69.

²⁷ Robinson, 329.

²⁸ Gentoku Toyoma, “Countering Threats in Space Through International Cooperation,” *Space Policy* 55 (February 2021): 5, <https://doi.org/10.1016/j.spacepol.2020.101387>.

²⁹ Toyoma, 5–6.

³⁰ Robert Manuel, “Coalition Space Operations: Exploring New Paths for Allied Partnerships” (master’s thesis, Naval Postgraduate School, 2018), 91, <https://apps.dtic.mil/dtic/tr/fulltext/u2/1059996.pdf>.

In literature approaching allied space cooperation from a perspective other than a global coalition structure, there are two distinct works produced by Scott Pace and the combined work of Pablo Alonso-García and Benjamin Silverstein. Pace, like Robinson in the *Handbook of Space Security*, addresses space cooperation with Japan. Where Robinson argues that the U.S. should coordinate efforts with Europe and Japan, Pace first takes a bilateral and then more regional approach, stating: “Japan should be the partner of choice for space cooperation in the Asia-Pacific region due to its relationship with the United States and its capabilities.”³¹ Pace appears to suggest that space cooperation would begin with Japan but emerge as a regional security effort amongst other allies of the United States. Resource pressures would drive cooperation such as “multilateral actions to coordinate and share costs will be necessary.”³² In the European theater, Alonso-García and Silverstein wrote a chapter in a report examining how the newly proposed European Union (EU) Space Agency and NATO could enhance European space security. Within this context, they have proposed an avenue of engagement for the United States to create a transatlantic space cooperation structure providing mutual security benefits.³³ These two writings are presented to show that there is not a total consensus in the literature that a global space architecture is the structure of choice.

Moltz’s 2011 literature review of the leading studies of space security determined “that there has been inadequate attention paid to the prospects of truly *allied* strategies to accomplish shared goals of space threat reduction, deterrence, and defense.”³⁴ Despite progress being made, the academic study of this topic remains insufficiently realized to wholly refute this claim. In the eleven years since the shift in American strategic thinking, there has not been the thorough investigation that is needed or development of an outlined

³¹ Scott Pace, “U.S. - Japan Space Security Cooperation,” in *Handbook of Space Security: Policies, Applications and Programs*, ed. Kai-Uwe Schrogl et al. (New York, NY: Springer, 2015), 352, https://doi.org/10.1007/978-1-4614-2029-3_34.

³² Pace, 353.

³³ Pablo Alonso-García and Benjamin A. Silverstein, “NATO and the E.U.: New Opportunities in Europe for Space Policy,” in *Space Strategy at a Crossroads: Opportunities and Challenges for 21st Century Competition*, ed. Benjamin Bahney (Livermore, CA: Center for Global Security Research Lawrence Livermore National Laboratory, 2020), 47.

³⁴ Moltz, “Coalitions in Space: Where Networks Are Power,” 14.

plan for how to integrate and structure an allied space network, particularly regarding Navy relevant issues or missions.

C. POTENTIAL EXPLANATIONS AND HYPOTHESES

Throughout history, nations have used alliances to garner international support, resist enemies, or broaden their pool of resources. Space should be no different. For the U.S. Navy to most effectively leverage the opportunity afforded by space, it must have an effective space network to rely upon. The question of how best to establish these alliances in space is a complex one. Military cooperation, as stated, is not new, but the idea of cooperating in space is a relatively new concept, emerging from an era of nationalistic Cold War thinking. In understanding how to structure these new alliances and leverage past cooperation, it is critical to understand how the United States has interacted with its allies in the European and Indo-Pacific theaters.

There are three methods for structuring a space coalition, of which, two examples are seen currently enacted in long-standing alliances of the United States. The least complex and easiest to initiate is a simple bilateral agreement. The United States would integrate one-on-one with a partner nation, reaching an agreement to share data, financial burdens, and other resources as agreed upon. The *Georgetown Journal of International Affairs* released an article, “U.S. Trans-Pacific and Trans-Atlantic Alliances: A Comparison,” assessing the state of U.S. military alliances in Asia and Europe.³⁵ In the article, Tongfi Kim, determines that U.S. security alliances in Asia have been bilateral in nature, whereas in Europe the alliances have been much larger multilateral endeavors, specifically citing the North Atlantic Treaty Organization (NATO) as the prime example. Naturally, the second possible structure for a space coalition would follow Kim’s example of NATO. An allied space coalition could be a regional affair, as is seen predominately throughout Europe, rather than the bilateral efforts in Asia. Finally, this leaves the last possible structure for space cooperation. A global coalition of United States allies expanded

³⁵ Tongfi Kim, “U.S. Trans-Pacific and Trans-Atlantic Alliances: A Comparison,” *Georgetown Journal of International Affairs*, January 6, 2019, <https://www.georgetownjournalofinternationalaffairs.org/online-edition/2019/1/6/us-trans-pacific-and-trans-atlantic-alliances-a-comparison>.

into the space domain is a potential structure for the United States to face the challenges of great power competition.

In examining these three coalition structures, it is expected that there will be impediments to cooperation, and, alternatively, there may be more favorable conditions that vary between the two regions. Political differences between allied nations in a space coalition would present a challenge. Established organizations such as the European Union or the European Space Agency (ESA) present institutional obstacles toward an allied network. Similarly, differences in experience level of military space programs could generate a point of friction. This friction was seen in the mid-1960s during the faltering development of the European Launcher Development Organization (ELDO), where German space efforts were seen to be lacking in comparison to the robust national space program and experience of the French and British.³⁶ This is by no means meant to be a comprehensive list. The intention is to acknowledge the variety of factors and conditions that warrant addressing. They present some of the potential impediments and conducive conditions when considering alliance building and will certainly have an impact on allied space coalition structural decisions.

D. RESEARCH DESIGN

As alluded to in previous sections, the research method supporting this thesis follows a comparative approach addressing three naval missions in Europe and in the Indo-Pacific. The research is scoped to focus only on existing allies with significant navies and space capabilities in each theater: France, United Kingdom, and Germany in Europe; and Japan, South Korea, and Australia in the Indo-Pacific. The three missions: communications, maritime domain awareness (MDA), and meteorological support, provide the basis for examples of future or existing cooperation and interoperability, and how they are enhanced by leveraging the space domain. Within that framework, this thesis weighs the risks and benefits of each of the three possible allied cooperation structures:

³⁶ Michael Sheehan, *The International Politics of Space*, 1st Edition (London: Routledge, 2007), 79, <https://doi.org/10.4324/9780203933909>.

bilateral, regional, or global, and, in its conclusion, provides recommendations for U.S. policy.

E. THESIS OVERVIEW AND CHAPTER OUTLINE

This thesis is structured in five parts with the first and last section being the introduction and conclusion. The second chapter, following the introduction, sets the stage and establishes the role of space in the maritime domain specifically in an era of renewed great power competition. The remaining two body chapters consist of two regional case studies examining Europe and the Indo-Pacific, respectively. Each regional chapter has a short conclusion section discussing the evidence presented in the chapter as it pertains to the various possible alliance systems or structures. The conclusion follows with a more robust analysis of findings, identifying the best structure for an allied space coalition. Moreover, it highlights how strengthening traditional alliances and developing formal space cooperation can be used as true force multiplier to meet the maritime challenges of the day in the context of great power competition with Russia and China.

II. RENEWED GREAT POWER COMPETITION: THE ROLE OF SPACE IN THE MARITIME DOMAIN

This chapter establishes an overview of the United States' great power adversaries and their use of space, especially as it pertains to the maritime domain. Specific challenges faced by navies operating at sea are addressed, as well as some of the space resources naval forces require for effective operations. Finally, a brief description of the role of maritime allies and the components critical to successfully leveraging these relationships as a force multiplier, is presented. The following sections are meant to set the stage for the regional case studies seen in Chapters III and IV.

Since the advent of space technology, the military application of this technology has been a focus of nations, especially the great powers. As it stands, aside from the United States, only Russia and China have significantly expanded their military space activities beyond reconnaissance.³⁷ Our rivals undoubtedly recognize the strategic necessity of space, especially as it pertains to the maritime domain. Writing in 1898, Mahan asserted that unmolested trade and shipping must be protected to ensure the welfare of a country.³⁸ Our rival great powers understand the importance of the maritime realm to their national interest. This can be seen by Russia's struggle with economic sanctions and the challenges it faces in energy exports; and China, the newly emerged global economic driver, seeking to advance its Belt and Road Initiative (BRI). Current military space activities consist mostly of supporting functions, enabling forces to operate more effectively in the air, on the ground, and in this case, most importantly— at sea.³⁹

³⁷ James Clay Moltz, *Crowded Orbits: Conflict and Cooperation in Space* (New York, NY: Columbia University Press, 2014), 177, <https://doi.org/10.7312/molt15912>.

³⁸ Alfred Thayer Mahan, *The Influence of Sea Power Upon History, 1660–1783* (Boston: Little, Brown and Company, 1898), 87.

³⁹ Moltz, *Crowded Orbits*, 122.

A. GREAT POWER ADVERSARIES: SPACE IN SUPPORT OF MARITIME OPERATIONS

Despite a downturn in the decade following the disbandment of the Soviet Union in 1991, Russia remains an international power in space. Russian President Vladimir Putin has stressed that space will allow their Armed Forces to reach their maximum potential, and that the Army and Navy must be prepared for an armed struggle. In 2018 Russian Defense Minister Sergey Shoygu stated regarding his president's comments: "The solution of this problem doubtlessly depends directly on the availability of a modern orbital constellation of military satellites."⁴⁰ Russia views the United States and NATO as the principal threats to its security and geopolitical aspirations, in turn precipitating Naval doctrine to project power in the Mediterranean, counter NATO forces, and secure the Arctic, specifically the Northern Sea Route, and its improved shipping routes.⁴¹ Russian military thinking, determined by the Defense Intelligence Agency (DIA), finds space critical to these efforts given the "growing role of precision weapons and satellite-supported information networks in all types of conflict."⁴² Some examples of these efforts include Russia's nuclear-powered ballistic missile submarine fleet modernization effort for strategic deterrence, use of the KALIBR land attack cruise missiles in precision strikes, as seen in Syria in October 2015, and coastal defense through anti-ship missile systems such as the STYX or SEPAL.⁴³

In spite of Russia's own buildup of space-based capabilities, they believe America to be over reliant on space, an "Achilles' heel," that they seek to neutralize, thereby offsetting a perceived military advantage.⁴⁴ To this end, electronic warfare (EW) is a high

⁴⁰ Defense Intelligence Agency, *Challenges to Security in Space*, DIA_F_01403_A (Washington, DC: Defense Intelligence Agency, 2019), 23, https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Space_Threat_V14_020119_sm.pdf.

⁴¹ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, DIA-11-1704-161 (Washington, DC: Defense Intelligence Agency, 2017), 15–27, <https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20Report%202017.pdf?ver=2017-06-28-144235-937>.

⁴² Defense Intelligence Agency, *Challenges to Security in Space*, 24.

⁴³ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 33–68.

⁴⁴ Defense Intelligence Agency, *Challenges to Security in Space*, 24.

priority for Russian maritime military operations. Capabilities to jam communication uplinks, and spoof, or jam positioning, navigation and timing (PNT) systems are being developed.⁴⁵ Assessed by the DIA, use of EW provides advantages twofold: First the technical disruption, denying an adversary use of a specified system, and secondly the capability to introduce confusion into the ranks of adversary decision makers, allowing “Russian forces to seize the operational initiative.”⁴⁶ The Russian General Staff believes that wartime strategies must be adopted that disrupt the information support and military C2 of adversaries, which in an era of informatized and network-centric warfare, is of vital importance.⁴⁷ Furthermore, the DIA concludes that Russia is of the belief that “the military capabilities to counter space operations will deter aggression by space-enabled adversaries and enable Russia to control escalation of conflict if deterrence fails.”⁴⁸ The authors of *Global Counterspace Capabilities* contend that Russian military operations actively employ counterspace capabilities, with evidence to support its use in the operations in eastern Ukraine.⁴⁹ This experience and technological foundation throughout Russian military and space programs can only serve to strengthen the need to be mindful of Russian counterspace capabilities.

Russian counterspace doctrine only begins with EW. Its counterspace programs are robust, with advances in more conventional hard kill focused methods and a divergence into cyber operations. In July 2018, Russian Aerospace Forces began to receive a laser weapon system, likely for use as a ground based ASAT.⁵⁰ Further evidence indicates that Russia has revived a Soviet era program to field an aircraft-borne laser system to target adversary imagery satellites, although this is not assessed to be operationally capable.⁵¹

⁴⁵ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment* (Washington, DC: Secure World Foundation (SWF), 2020), 67, <https://swfound.org/counterspace/>.

⁴⁶ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 42.

⁴⁷ Defense Intelligence Agency, 36.

⁴⁸ Defense Intelligence Agency, 36.

⁴⁹ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, 51.

⁵⁰ Defense Intelligence Agency, *Challenges to Security in Space*, 29.

⁵¹ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, 71.

Russia has a proven capability of direct ascent ASATs, however this is assessed by the Secure World Foundation as unlikely to pose a critical threat to U.S. assets, due to the limited capacity on hand, and technological limitations capable of only targeting LEO satellites.⁵²

In addition, the DIA reports that in 2017 Russia deployed a dual-use co-orbital system, which it described as an “inspector satellite capable of diagnosing the technical condition of a Russian satellite from the closest possible distance.”⁵³ In the same report, the DIA maintains that this inspection technology could also be used to approach, and conduct an attack on an adversary’s satellite, and that this “behavior is inconsistent with on-orbit inspection activities or space situational awareness capabilities.” Finally, regarding Russian cyber operations, Weeden and Samson report the Russian belief that information dominance operations begin prior to a conflict and that denying or corrupting space-based information will “mislead an adversary into making decisions contrary to their military objectives.”⁵⁴ The DIA supports this viewpoint, reporting on military academics who propose the fusion of EW and cyber operations in an effort to disrupt the electromagnetic spectrum, and “to corrupt and disable computers and networked systems.”⁵⁵ Russian perception of future threats and the nature of warfare are fairly well understood, in that space is critical to modern military and maritime operations, and Russia will certainly continue investment in and reliance upon the space domain.⁵⁶

China relies upon the maritime domain as an integral part to both its continued economic rise through the Belt and Road Initiative (BRI), and its greater strategic planning calculus. The South China Sea is a central focus of Chinese national interests, and a source of dispute, reflected in the territorial claim of the nine-dash line, which overlaps the exclusive economic zones (EEZ) of five other nations in Southeast Asia — Brunei,

⁵² Secure World Foundation, 61.

⁵³ Defense Intelligence Agency, *Challenges to Security in Space*, 29.

⁵⁴ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, 78.

⁵⁵ Defense Intelligence Agency, *Challenges to Security in Space*, 42.

⁵⁶ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, 78.

Indonesia, Malaysia, the Philippines, and Vietnam.⁵⁷ Tensions grow as China seeks to impose its will on the region, initially having risen from the discovery of robust natural resources in the 1960s, specifically, oil and natural gas, and now ranging from sovereignty disputes to fisheries claims.⁵⁸ For these reasons, the DIA suspects that Chinese military planners find “its future wars mostly will be fought outside its borders and will involve conflict in the maritime domain.”⁵⁹ For China to assert itself and project power broadly throughout the region and defeat high-tech adversaries, namely the United States, control of and access to space as the ultimate high ground, is essential.⁶⁰

The People’s Liberation Army (PLA) was directed by Beijing in 2015 to be able to win “informatized local wars” in the context of military struggle at sea.⁶¹ This resulted in the creation of the Strategic Support Force (SSF), with a focus on space systems and satellite launch operations to support the PLA in the following missions: ISR, navigation, and communication.⁶² Chinese naval strategy is very pointed in its intent to modernize its maritime force, as quoted in a DIA excerpt of *China’s Military Strategy*, a modern maritime force will “safeguard its national sovereignty and maritime rights and interests, [and] protect the security of strategic SLOCs (sea lines of communication) and overseas interests.”⁶³ The People’s Liberation Army-Navy (PLAN) draws heavily on the SSF space network not directly for combat operations, but as a means of enabling long-range, off-shore operations. Their ISR systems are used to monitor, track, and target United States

⁵⁷ Zhiguo Gao and Bing Bing Jia, “The Nine-Dash Line in the South China Sea: History, Status, and Implications,” *The American Journal of International Law* 107, no. 1 (January 2013): 121; Jonathan A. Haynes (Col), “Maritime Domain Awareness: An Entry Point for Force Design 2030 Implementation,” *The Marine Corps Association and Foundation* (blog), June 8, 2020, <https://mca-marines.org/blog/2020/06/08/maritime-domain-awareness-an-entry-point-for-force-design-2030-implementation/>.

⁵⁸ Gao and Jia, “The Nine-Dash Line in the South China Sea,” 105.

⁵⁹ Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win*, DIA-02-1706-085 (Washington, DC: Defense Intelligence Agency, 2019), 24, https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/China_Military_Power_FINAL_5MB_20190103.pdf.

⁶⁰ Kevin Pollpeter, “China’s Space Program: Making China Strong, Rich, and Respected,” *Asia Policy* 15, no. 2 (April 2020): 14.

⁶¹ Defense Intelligence Agency, *Challenges to Security in Space*, 14.

⁶² Defense Intelligence Agency, 14.

⁶³ Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win*, 64.

and allied forces throughout the Indo-Pacific.⁶⁴ The DOD *2019 Indo-Pacific Strategy Report* lists space as one of China's military programs of investment to provide "anti-access/area denial (A2/AD) capabilities, which could be used to prevent countries from operating in areas near China's periphery," meaning the South China Sea, East China Sea and region of the Korean Peninsula.⁶⁵ The PLA operates four dedicated military satellite communication (SATCOM) assets enabling Command and Control (C2) of maritime forces, and is investing further in quantum-enabled communications for even more highly secure communications.⁶⁶ As of June 2020, China has completed its domestic PNT system, Beidou, granting PLAN ships and coastal defense forces PNT data for navigation and advanced weapons systems, not only throughout the Indo-Pacific, but globally, as China continues operations outside its traditional sphere of influence.

Chinese counterspace capabilities pertaining to maritime operations have centered on electronic warfare (EW). Their doctrine emphasizes EW weapons to "suppress or deceive" adversaries' equipment.⁶⁷ China has proven proficient in GPS jamming capabilities and, in April 2018, satellite imagery confirmed the use of mobile military jamming trucks located on Mischief Reef, in the South China Sea.⁶⁸ The Chinese continue to invest in jamming capabilities of SATCOM, with evidence of specific capacity against the protected military frequency of extremely high frequency (EHF), as well as jamming of synthetic aperture radar (SAR) platforms like LEO reconnaissance satellites.⁶⁹ As early as 2005–06, reports emerged on the possibility that China had begun testing directed-energy weapons, blinding United States optical surveillance satellites.⁷⁰ It is assessed that

⁶⁴ Defense Intelligence Agency, *Challenges to Security in Space*, 19.

⁶⁵ Department of Defense, *The Department of Defense Indo-Pacific Strategy Report: Preparedness, Partnerships, and Promoting a Networked Region* (Washington, DC: Department of Defense), 8, accessed November 19, 2020, <https://media.defense.gov/2019/Jul/01/2002152311/-1/-1/1/DEPARTMENT-OF-DEFENSE-INDO-PACIFIC-STRATEGY-REPORT-2019.PDF>.

⁶⁶ Defense Intelligence Agency, *Challenges to Security in Space*, 19.

⁶⁷ Defense Intelligence Agency, 18.

⁶⁸ Secure World Foundation, *Global Counterspace Capabilities: An Open Source Assessment*, 42.

⁶⁹ Secure World Foundation, 42.

⁷⁰ Secure World Foundation, 45.

by 2020 China will likely field a fully capable ground-based laser weapon with the potential to counter sensors on LEO satellites, and by the mid-to-late 2020s may field a new laser that could threaten the structure of the satellite itself.⁷¹ Space is integral to the military strategy of the PLAN. It enhances their own operations and provides the capacity to enact their A2/AD strategy for the Indo-Pacific. They look to space to degrade the capabilities of their adversaries and will likely continue to invest in these capabilities.

B. CHALLENGES IN THE MARITIME ENVIRONMENT AND THE OPPORTUNITY OF SPACE

There are inherent risks and challenges to operating at sea posed by unpredictable weather, and the maritime environment. Many of the same obstacles faced during the days of sail, still challenge navies of today, albeit they are addressed entirely differently, by using technologies of the modern era. Vast distances, unpredictable weather, and simply the sheer size of the maritime battlespace present challenges to naval operations. Couple the natural challenges of the environment with revisionist great powers, and one begins to understand the current scope of the challenges faced by the United States Navy and its allies.

1. Communications

Arguably the most important component of any military operation is the ability to communicate. Whether it is communication between ships, aircraft, or to higher headquarters, no major naval operation can succeed without the ability to transmit orders, direct movement of forces, or coordinate efforts. Modern naval operations take place thousands of miles away from home port, and the operational units themselves are often geographically dispersed, thereby only increasing the need for long-range communications provided by SATCOM. In the modern era of network-centric warfare, communication at sea is expanded well beyond traditional measures. As discussed in a Naval Research Council study, these expanded communications include “command and control, battle management, the dissemination of common operational and tactical pictures, sensor-data

⁷¹ Defense Intelligence Agency, *Challenges to Security in Space*, 20.

dissemination, the tracking and engagement of time-sensitive and other targets, and many other C4ISR functions.”⁷²

The extraordinary demand for non-voice communication, enabling Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) functions of a modern navy, presents its own challenge. Witnessed during Operation Iraqi Freedom, even with the new Global Broadcast System (GBS) operating in the EHF spectrum with broad area coverage and spot beam technology, naval ships received only 20 Mbps, which proved inadequate for operational requirements.⁷³ Without reliable access to SATCOM for beyond line of sight (BLOS) communication, a navy is limited to HF systems. This is concerning for several reasons. HF is limited in range, data speeds, bandwidth, and reliability, and is far too easy for adversaries to intercept using high frequency direction finding (HF/DF) technology.⁷⁴

For the U.S. Navy, the challenge of maintaining a secure, reliable, and resilient communication architecture is crucial for effective operations at sea. Without modern SATCOM, the full capability of the Navy cannot be realized, and it would be forced to fall back upon capability-limiting technology from yesteryear.

2. Maritime Domain Awareness

An effective communication architecture is critical for command-and-control functions and an enabling factor for the maritime domain awareness (MDA) mission. From the National Maritime Domain Awareness Plan (NMDAP), this mission is defined as “the effective understanding of anything associated with the maritime domain that could impact the security, safety, economy, or environment of the United States.”⁷⁵ Although generated

⁷² National Research Council (U.S.), ed., *C4ISR for Future Naval Strike Groups* (Washington, D.C: National Academies Press, 2006), 151, <https://www.nap.edu/read/11605/chapter/1>.

⁷³ National Research Council (U.S.), 25.

⁷⁴ Friedman, *Seapower and Space*, 57–62.

⁷⁵ Department of Homeland Security, *National Maritime Domain Awareness Plan for The National Strategy for Maritime Security* (Washington, DC: Department of Homeland Security, 2017), iv, <https://nmio.isc.gov/Portals/16/Docs/National%20MDA%20Plan%202017%20Update%2020170215.pdf?ver=20>.

by the Department of Homeland Security (DHS), the definition remains sound, and is the same definition that Admiral Michael G. Mullen used during his tenure as the Chief of Naval Operations.⁷⁶ Without the ability to communicate and report on vessels, aircraft, or other items of interest to the MDA mission, commanders would be rendered unable to make sound and efficient decisions.

Aside from the supporting role of communications, the MDA mission itself is complicated simply by operating in such a vast environment. The conventional assets required to gain an effective understanding of everything within the maritime domain are extraordinary. This is the opportunity provided by space. Satellite assets do not require the sleep, maintenance, or fuel required by a commensurate terrestrial platform. Throughout Southeast Asia, for example, despite the widely acknowledged MDA challenge, Mike Yeo asserts: “nations have not actively pursued maritime patrol aircraft, or MPA, preferring instead to prioritize other acquisitions in the face of budget requirements.”⁷⁷ The costs of these sophisticated aircraft are prohibitive, which makes satellites an attractive alternative. They need not be nationally owned to enjoy their benefits, and the data provided by such an asset can be sold and shared amongst allies, at a fraction of the cost of a nationally owned maritime patrol aircraft (MPA), such as the P-8A Poseidon. The U.S. and allied countries have robust space-based ISR capabilities including: ELINT, EO/IR, and SAR satellites. These platforms, argues the National Research Council, contribute to the MDA mission by providing “Target identification, location, and tracking.”⁷⁸ Aircraft, ships, and other platforms contributing to the combined maritime picture can never achieve the persistence or coverage capacity provided by a satellite. This is not to rule out the role conventional platforms, for they still provide vast data within the MDA framework. It is

⁷⁶ Haynes (Col), “Maritime Domain Awareness: An Entry Point for Force Design 2030 Implementation.”

⁷⁷ Mike Yeo, “There’s No Shortage of Threats in the Southeast Asian Seas. So Why Aren’t Residents Buying Maritime Patrol Aircraft?,” Defense News, February 6, 2020, <https://www.defensenews.com/digital-show-dailies/singapore-airshow/2020/02/11/theres-no-shortage-of-threats-in-the-southeast-asian-seas-so-why-arent-residents-buying-maritime-patrol-aircraft/>.

⁷⁸ National Research Council et al., *Navy’s Needs in Space for Providing Future Capabilities* (Washington, D.C., UNITED STATES: National Academies Press, 2005), 42, <http://ebookcentral.proquest.com/lib/ebook-nps/detail.action?docID=3377965>.

simply to highlight the opportunity that space provides for persistent coverage and contribution to the data-fusion efforts. Additionally, the majority of conventional maritime surveillance systems currently rely upon satellite technology at least in part, and, as argued by Nardon and Venet, the capabilities of other systems “could be strongly enhanced by the use of space.”⁷⁹

3. Meteorological and Oceanographic Operations

Military operations have two major sources of risk: unpredicted enemy activities and unpredictability of the environment.⁸⁰ Anyone who has been to sea can understand the vast variability in weather patterns and environmental conditions. Weather can change hour by hour, and mile by mile, impacting navigation, communication, and operability of integral sensors. This unpredictability can cause major damage, loss of life, and, in the worst cases, even the sinking of the ships themselves. In World War II Admiral Halsey lost three destroyers from Task Force 38; limited by technology of the time, weather forecasters on the Third Fleet Staff, had very little capability to track typhoons and other weather patterns.⁸¹ On December 18, 1944, a major storm in the Philippine Sea struck Task Force 38 and sank three destroyers: USS *Hull*, USS *Spence*, and USS *Monaghan* with nearly all hands onboard.⁸² In total, nearly 790 men were lost, another 80 wounded, with fires further destroying 146 planes, in addition to the three warships.⁸³

Similar, to how effective communications are inherent to the MDA mission, meteorological data plays a supporting role to many naval missions, not just for weather

⁷⁹ Laurence Nardon and Christophe Venet, “The Use of Space for Maritime Security in Europe,” *Actuelles de l’Ifri, The Europe & Space Series 5* (June 2011): 2.

⁸⁰ National Research Council, *Environmental Information for Naval Warfare* (National Research Council of the National Academies, 2001), 50, <https://www.nap.edu/read/10626/chapter/1#ii>.

⁸¹ Samuel J. Cox, “H-039-2: Typhoon Cobra—The Worst Natural Disaster in U.S. Navy History, 14–19 December 1944,” Naval History and Heritage Command, December 2019, <https://www.history.navy.mil/about-us/leadership/director/directors-corner/h-grams/h-gram-039/h-039-2.html>.

⁸² “Typhoons and Hurricanes: Pacific Typhoon, 18 December 1944,” Naval History and Heritage Command, November 13, 2017, <https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/p/pacific-typhoon-18-december-1944.html>.

⁸³ Naval History and Heritage Command.

prediction but estimates on sensor performance in all domains. The purpose of meteorological and oceanographic (METOC) operations, outlined in Joint Publication 3-59, is to generate METOC information, which is defined as: “Actionable information to include meteorological, climatological, oceanographic, and space environment observations, analyses, prognostic data or products, and meteorological and oceanographic effects.”⁸⁴ More plainly stated, in JP 3-59, “METOC support is critical to providing the commander with awareness of the environmental components of the operational environment (OE) and the ability to exploit that awareness to gain an operational advantage during military operations.”⁸⁵ Without effective METOC products, modern naval operations will continue to be influenced and degraded by environmental uncertainty.

To date, the majority of observational data used by the METOC community is derived from satellites or other automated weather stations.⁸⁶ This data is used by METOC forces to model degradation to communications, radars, and navigation systems, allowing commanders to better understand the mission impact.⁸⁷ Meteorological satellite data is widely disseminated and available through various near-real time means such as direct broadcast, Global Telecommunication System (GTS), or simply from the internet.⁸⁸ Furthermore METOC data can be optimized, persistent, and in many instances made more timely through the use of satellites, either for initial observation or dissemination. As noted in JP 3-59, effective METOC data is leveraged by commanders to exploit the environment, by “minimizing or mitigating any negative effects of the environment on friendly forces while simultaneously capitalizing on conditions that maximize the operational advantage over enemy forces.”⁸⁹

⁸⁴ Joint Chiefs of Staff, “JP 3-59: Meteorological and Oceanographic Operations,” January 10, 2018, GL-4.

⁸⁵ Joint Chiefs of Staff, I-1.

⁸⁶ National Research Council, *Environmental Information for Naval Warfare*, 88.

⁸⁷ Joint Chiefs of Staff, “JP 3-59: Meteorological and Oceanographic Operations,” C-4.

⁸⁸ “Data and Product Dissemination,” World Meteorological Organization, accessed March 13, 2021, http://www.wmo.int/pages/prog/sat/datadissemination_en.php.

⁸⁹ Joint Chiefs of Staff, “JP 3-59: Meteorological and Oceanographic Operations,” I-4.

The United States Navy and its allies continue to face uncertainty at sea, in both routine operations and any future conflict. METOC data, in terms of reliability, accuracy, and ease of dissemination remains an operational necessity. This can be achieved through the use of satellites and their hosted sensors. Space provides a means of efficient dissemination of data from shore facilities to sea, as well as the capability to collect observations in the first place. This technology is integral to naval operations, providing sound environmental estimates for operational planning and mission execution.⁹⁰

C. SPACE: A FORCE MULTIPLIER IN THE MARITIME DOMAIN

The scope and resources required for effective maritime security efforts have changed dramatically since the Cold War, requiring a new way of conducting operations in the maritime domain. Announced in 2005 by then-CNO Admiral Mike Mullen, an international collaborative maritime design was proposed, initially branded the “1,000-ship Navy” or Global Maritime Partnership (GMP).⁹¹ This was in recognition of the emerging “dynamic maritime security landscape” spanning a broad range of missions, in which the authors of *Maritime Security Partnerships* determined “No single navy or nation can do this alone.”⁹² In 2014, Admiral Jonathan Greenert found a need to move beyond the framework of GMP, and proposed a Global Network of Navies (GNoN), which would “allow countries with converging interests in the maritime domain to form mission-focused—often temporary—goal-oriented associations to address common maritime-security challenges,” which he proposed was more efficient because it did not require the years needed in developing close partnerships.⁹³ Admiral Greenert was recognizing the fiscal challenges faced by modern navies, and the need for low-cost, innovative avenues to address emerging threats and instability.⁹⁴ Space is the innovative avenue and, when

⁹⁰ Joint Chiefs of Staff, I-4.

⁹¹ National Research Council, *Maritime Security Partnerships*, N00014-05-G-0288 (Washington, DC: National Academies Press, 2008), ix, <https://doi.org/10.17226/12029>.

⁹² National Research Council, ix.

⁹³ Jonathan Greenert and James M. Foggo, “Forging a Global Network of Navies,” *United States Naval Institute. Proceedings* 140, no. 5 (May 2014): 22–29.

⁹⁴ Greenert and Foggo.

managed correctly, can be relatively low-cost compared to resources required to field conventional naval assets with an equivalent capability. In the context of maritime domain awareness, which is critical to ensuring maritime security, satellite constellations will act as a force multiplier, reducing the need for costly conventional warships and presence operations.

1. Alliance Building

To fully address the three structures of allied space cooperation outlined in Chapter I, and to evaluate their merit over the next two chapters, through regional case studies of Europe and the Indo-Pacific, a baseline must be established for what an alliance is and the key components of a stable alliance. Claudette Roulo writes that for the DOD, a true alliance relationship is that in which a formal agreement between two or more nations has been reached, and this relationship will have signed documentation that “promises each nation will support the other, particularly during war.”⁹⁵ Anything less formal than a “treaty ally” would fall under a partnership, or what is often termed a “strategic partnership,” and is often used in “information exchanges” and to build mutually beneficial cooperation.⁹⁶ The United States has traditionally entered bilateral and multilateral alliances in which it could best leverage its power.⁹⁷ As explained by Gause et al., many of its naval alliances were designed to “counter an expansionist Soviet aggressor.”⁹⁸ Given the renewed desire for cooperation and allied engagement over the last eleven years, the historical nature of the United States’ naval alliances will need to be accounted for.

The benefits of military alliances and partnerships are transparent on the surface; however, there can be some drawbacks to these relationships. Nations will often enter an alliance with the purpose of sharing costs, and risks, and increasing their chances of

⁹⁵ Claudette Roulo, “Alliances vs. Partnerships,” U.S. Department of Defense, March 22, 2019, <https://www.defense.gov/Explore/Features/Story/Article/1684641/alliances-vs-partnerships/>.

⁹⁶ Roulo.

⁹⁷ Elizabeth Sherwood-Randall, *Alliances and American National Security*: (Fort Belvoir, VA: Defense Technical Information Center, 2006), iii, <https://doi.org/10.21236/ADA457160>.

⁹⁸ Kenneth Gause, Catherine Lea, and Daniel Whiteneck, *U.S. Navy Interoperability with Its High-End Allies* (Alexandria, Virginia: Center for Strategic Studies, 2000), 1, http://www.dodccrp.org/events/5th_ICCRTS/papers/Track3/080.pdf.

success; in short, an alliance is a means of increasing security and can be used as deterrence against external aggression.⁹⁹ That being said, there is a major hurdle that merits acknowledging, as it is a key component in any cooperative structure, be it a formal treaty alliance or strategic partnership. The idea that states make policy concessions, or at a minimum must be more flexible in their foreign policy decisions when entering a military alliance is a factor to balance against a nation's security interests.¹⁰⁰ This balance, also, must be accounted for when considering the size and nature of any cooperative efforts, especially when bearing in mind larger multinational efforts or a global coalition structure.

2. Interoperability within Coalitions

The effectiveness of any potential coalition or alliance is limited in some regard by the ability of the member nations' militaries to interact and operate together. In the same line of thinking, for space to be used as a force multiplier, these militaries' space systems, must also have some commonality in technology or communication structure. Considering that security issues rarely fit so neatly into one region or subregion, and often cross these geographic boundaries, it is in the interest of the United States and partner nations to have the ability to broadly share information.¹⁰¹ This gives rise to the concept of interoperability.

From the Center for Strategic Studies, "Interoperability is defined as the ability of systems, units and forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together."¹⁰² Strictly speaking, the technological ability to exchange data and information, is not the sole impediment to interoperability. The legal issue of sharing data, which may be tied up in confidentiality agreements, can be a larger impediment than the

⁹⁹ Sherwood-Randall, *Alliances and American National Security*, 14.

¹⁰⁰ Jesse C Johnson, "The Cost of Security: Foreign Policy Concessions and Military Alliances," *Journal of Peace Research* 52, no. 5 (2015): 665–79.

¹⁰¹ National Research Council, *Maritime Security Partnerships*, 52–53.

¹⁰² Gause, Lea, and Whiteneck, *U.S. Navy Interoperability with Its High-End Allies*, 2.

technology.¹⁰³ Within the coalition structure, Dittmer proposes: “Other states may well agree that their data are a sovereign resource not to be shared.”¹⁰⁴ So, in approaching any form of allied or partner cooperation, as derived from *U.S. Navy Interoperability with Its High-End Allies*, it will be important to remember that “seamless interoperability between the U.S. Navy and allied navies is not likely. It is probably an unachievable goal.”¹⁰⁵ Seamless integration could be viewed as the ultimate goal, however, with the understanding that— for financial, political, legal, or other technological reasons— it may not be fully realized. Militaries are not exempt from their broader national economies, and even when military readiness appears to be stable, Dittmer argues, it “may reach a tipping point in which certain military capabilities dissipate.”¹⁰⁶ This ebb and flow in capability and funding of individual nations will simply become a part of the greater structure to be balanced by the remaining partner nations. Whether it is caused by funding, politics, or other motivations, there will be always be some form of interoperability gap, albeit likely an asymmetric and volatile gap. As highlighted by Gause et al., in a report from the Center for Strategic Studies, “The best that the U.S. and its allies can hope for is to intelligently manage the gap to prevent it from metastasizing to the point where coalitions are not able to work around issues that could threaten the operation.”¹⁰⁷

D. CONCLUSION

Having established the conditions and context of which an allied maritime space coalition must operate, the following two chapters endeavor to examine various coalition structures, and their merits and shortfalls for addressing the strategic problems of Europe and the Indo-Pacific. Chapter III has a focus on competition with Russia in the Mediterranean and Arctic Oceans, addressing regional allies, specifically: Germany,

¹⁰³ Jason Dittmer, “The State, All at Sea: Interoperability and the Global Network of Navies,” *Environment and Planning C: Politics and Space*, November 14, 2018, 11, <https://doi.org/10.1177/2399654418812469>.

¹⁰⁴ Dittmer, 11.

¹⁰⁵ Gause, Lea, and Whiteneck, *U.S. Navy Interoperability with Its High-End Allies*, 4.

¹⁰⁶ Dittmer, “The State, All at Sea,” 4.

¹⁰⁷ Gause, Lea, and Whiteneck, *U.S. Navy Interoperability with Its High-End Allies*, 40.

France, and the United Kingdom. Whereas Chapter IV similarly has a regional focus, addressing the Chinese influence over the South China Sea through the Korean Peninsula, and the role of alliances with Japan, Australia, and South Korea. Ultimately as stated in Chapter I, the end state is to formulate the most beneficial space coalition structure to meet the maritime the challenges of the day, as pertaining to great power competition in these strategically important regions.

III. BUILDING A EUROPEAN SPACE COALITION TO SUPPORT NAVY OPERATIONS

Having established the contextual framework, and defined the intended scope of discussion in Chapter II, a case study and examination of current U.S. allies and their roles in varying space coalition structures is examined in Chapter III. To this end, the chapter opens with a discussion of the strategic challenges faced in the European theater pertaining to maritime competition with Russia and the existing organizations that will have an influence on the politics at play. Current alliances with Germany, France, and the United Kingdom are evaluated in terms of their space programs, the state of space cooperation with the United States, and capabilities they possess that might offer avenues for further or future space cooperation. The third part of this chapter addresses the capabilities of our allies and their impact on specific naval missions: communication, MDA, and METOC. The chapter concludes with a comparison of the three proposed allied space cooperation structures, seeking to build a foundation of evidence, that is the basis for proposing policy recommendations and determination of the best allied space cooperation structure offered in Chapter V.

A. STRATEGIC IMPORTANCE

The strategic and political interests of the United States and its allies throughout Europe are threatened by Russia's aggressive actions and use of force, which NATO describes as "undermin[ing] Euro-Atlantic security and the rules-based international order."¹⁰⁸ Argued by Abenheim, et. al., "The U.S. Navy has long been the backbone of U.S. global influence and leadership," resulting in the "necessity for this nation to project significant power in maritime forces throughout the world's oceans."¹⁰⁹ Renewed Russian aggression, first seen in 2008 with the case of Georgia, and more recently the actions in

¹⁰⁸ "Deterrence and Defence," North Atlantic Treaty Organization, June 25, 2021, https://www.nato.int/cps/en/natohq/topics_133127.htm.

¹⁰⁹ Donald Abenheim et al., "American Sea Power in the Contemporary Security Environment," *Comparative Strategy* 37, no. 5 (2018): 400.

Crimea and Syria— in 2014-present and 2016-present— only serve to further highlight the “importance of the U.S. Navy in this moment of geopolitical shift.”¹¹⁰

1. Mediterranean and the Arctic

When considering the maritime realm within the European theater, there are two unique subregions that have emerged in recent years as points of contention and strategic importance: the Mediterranean Sea and the Arctic. These regions are of great strategic and economic value to Russian security and geopolitical aspirations. That said, Russian military strategy has the aim of countering U.S. and NATO forces throughout these regions. Likewise, the United States and its European allies have vested interests in regional security, freedom of navigation, and the natural resources of the same regions. Similarly, the Baltic and Black Seas remain bastions of Russian influence and activity, parallels seen from Cold War, where Abenheim et al. attest these seas are the “border between the NATO central front and its northern flank”.¹¹¹ However, current naval operations and strategic interest are vastly more prevalent throughout the Mediterranean and expanding into the Arctic. To this end, further exploration, and discussion of the Baltic and Black Seas have been withheld, while maintaining that the utility of allied space cooperation realized in the Mediterranean and Arctic will likewise apply to other European regions.

The Mediterranean Sea is a strategic crossroads between Europe, the Middle East, and Africa. Writing for the Hoover Institution, Jakub Grygiel asserts: “Because the Mediterranean is recognized as a lever of influence over Europe, it has always attracted external powers whose interests transcend this sea and focus on Europe.”¹¹² Grygiel expands further on this notion, highlighting the importance of the American transatlantic partnership when he states “the stability of the Mediterranean can be guaranteed only when one power (or friendly powers) controls access to it as well as its circumference.”¹¹³

¹¹⁰ Abenheim et al., 396.

¹¹¹ Abenheim et al., 397.

¹¹² Jakub Grygiel, “The Importance of the Mediterranean Sea,” Hoover Institution, January 10, 2020, <https://www.hoover.org/research/importance-mediterranean-sea>.

¹¹³ Jakub Grygiel.

NATO Secretary General Jens Stoltenberg echoes many of these sentiments. Discussing Russian activity in his 2020 Annual Report, the Secretary General states: “Russia’s behaviour remains assertive and destabilising, and terrorism continues to represent a global security challenge and a threat to stability.”¹¹⁴ Further commenting that the security challenges are too big for any “ally to face alone,” Stoltenberg argues for his 2030 initiative, “strengthening the transatlantic bond and doing more together.” The NATO Mediterranean dialogue “reflects the Alliance’s view that security in Europe is closely linked to security and stability in the Mediterranean.”¹¹⁵ Ultimately, if U.S. interests remain aligned with Europe, the Mediterranean will continue as a strategic focal point.

With vast resources and economically advantageous sea routes opening as a result of receding polar ice caps, the Arctic has become a source of international friction. A DOD report to Congress on Arctic Operations and the Northwest Passage details that the region is “warming on average twice as fast as the rest of the planet, resulting in increased human activity in the region.”¹¹⁶ The United States Geological Survey (USGS) estimates that roughly 22% of the world’s undiscovered oil and gas reserves reside in the Arctic.¹¹⁷ By Russian estimates, reported by Darren Boyle, the natural resources alone in the Arctic are worth well over \$30 trillion.¹¹⁸ The Russians view the Arctic as their backyard and territory. To this end, in 2007, a Russian submarine planted a rust-proof titanium flag on the seabed of the North Pole, a depth of 4,261 meters, symbolically staking their claim.¹¹⁹

¹¹⁴ North Atlantic Treaty Organization, *The Secretary General’s Annual Report* (Brussels, Belgium: North Atlantic Treaty Organization, 2020), 12, https://www.nato.int/nato_static_fl2014/assets/pdf/2021/3/pdf/sgar20-en.pdf.

¹¹⁵ North Atlantic Treaty Organization, “NATO Mediterranean Dialogue,” North Atlantic Treaty Organization, February 13, 2015, http://www.nato.int/cps/en/natohq/topics_60021.htm.

¹¹⁶ Department of Defense, *Report to Congress on Arctic Operations and the Northwest Passage*, 5–750938C (Washington, DC: Department of Defense, 2011), 2, https://archive.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf.

¹¹⁷ Roncevert Ganan Almond, “U.S. Ratification of the Law of the Sea Convention,” *The Diplomat*, May 24, 2017, <https://thediplomat.com/2017/05/u-s-ratification-of-the-law-of-the-sea-convention/>.

¹¹⁸ Darren Boyle, “Russia Tightens Its Grip on the Arctic with Military Base in Polar Region Rich in Resources,” *Daily Mail*, April 4, 2019, <https://www.dailymail.co.uk/news/article-6888103/Russia-tightens-grip-Arctic-military-base-polar-region-rich-resources.html>.

¹¹⁹ Sandrine Baccaro and Philippe Descamps, “Sailing around the Top of the World; The Era of the Icebreaker,” *Le Monde Diplomatique, English Ed.*, May 2020, <http://www.proquest.com/docview/2395391997/abstract/516901C2F1654ED4PQ/14>.

The Russian Federation submitted a claim to the U.N. in 2015 for 463,000 square miles of the Arctic, expanding their Exclusive Economic Zone (EEZ) out to 350 NM, 150 NM in excess of the 200 NM recognized by international law and ratified in the United Nations Convention for Laws of the Sea (UNCLOS).¹²⁰ In response to the resources at stake, as of May 2020, Norway and Denmark have filed similar claims to extend their EEZs, with the Canadians preparing to submit their own claim.¹²¹ Michael Murphy, the State Department's deputy assistant secretary for European and Eurasian Affairs, when asked about Russian military expansion in the Arctic, including the establishment of an Arctic base, coastal missile batteries, early warning radars and air defenses, testified in February 2020: "Russia's military buildup in the Arctic threatens the United States' and NATO's northern flank."¹²² Murphy concluded: "In short, NATO's northern flank must once again command the attention of the United States and its allies."¹²³

2. Maritime Challenges

Maritime challenges faced throughout the entire European theater have emerged because of both geopolitics of the region and great power competition with Russia. Furthermore, the geography and interconnectedness of the overall European region present additional challenges to be faced by maritime forces throughout the Mediterranean and the Arctic.

a. The Mediterranean

United States strategic goals in the Mediterranean are to counter Russian expansion, show strong regional leadership in concert with NATO allies, and engage in regional power projection. This is accomplished through multinational naval exercises, assisting in maritime security efforts, and providing humanitarian assistance and disaster relief (HA/

¹²⁰ Boyle, "Russia Tightens Its Grip on the Arctic with Military Base in Polar Region Rich in Resources."

¹²¹ Baccaro and Descamps, "Sailing around the Top of the World; The Era of the Icebreaker."

¹²² David Larter, "The U.S. Navy Returns to an Increasingly Militarized Arctic," Defense News, May 12, 2020, <https://www.defensenews.com/naval/2020/05/11/the-us-navy-returns-to-an-increasingly-militarized-arctic/>.

¹²³ Larter.

DR). Chris Gibson of the Hoover Institution contends that Russian escalation and investment in Syria is a means to “shore up Russian control of the Port of Tartus,” and their diplomatic relations with Turkey are “designed to drive a wedge in NATO and further Russian influence in the Mediterranean region.”¹²⁴ The way forward, Gibson argues, is to double down on alliances and cooperation in the region. Citing limited resources of the United States, Gibson proposes that “We can’t be everywhere, all the time, and thus a major shift in resources to the Mediterranean is not possible, nor needed.”¹²⁵ The challenges will need to be met through innovation and cooperation, not simply through American finances.

A RAND report contends that Europe’s greatest challenge found in the Mediterranean is the issue of migration.¹²⁶ Political instability throughout much of the Eastern Mediterranean, stemming initially from the December 2010 Arab Spring, has generated a refugee crisis. Rubin and Eiran write: “the sea is the primary route to refuge, with approximately 95 percent of refugees crossing the Mediterranean.”¹²⁷ Data from the United Nations High Commissioner for Refugees (UNHCR) shows that from 2014 to April 17, 2021, an estimated 2,194,696 refugees had entered European countries, and 20,897 were missing or lost their lives in the attempted passage.¹²⁸

Amongst this unrest and instability, many maritime challenges have arisen both directly and indirectly. As stated previously, irregular migration is one of the greatest challenges; however, increased maritime terrorism and piracy have resulted from the

¹²⁴ Chris Gibson, “Refining U.S. Strategy in the Mediterranean,” *Strategika*, no. 62 (January 10, 2020), <https://www.hoover.org/research/refining-us-strategy-mediterranean>.

¹²⁵ Gibson.

¹²⁶ Michael J. McNerney, Giacomo Persi Paoli, and Sarah Grand-Clement, *Cross-Cutting Challenges and Their Implications for the Mediterranean Region*, PE-222-RC (Santa Monica, CA: RAND, 2017), 3, <http://www.jstor.com/stable/resrep02407>.

¹²⁷ Aviad Rubin and Ehud Eiran, “Regional Maritime Security in the Eastern Mediterranean: Expectations and Reality,” *International Affairs* 95, no. 5 (September 1, 2019): 986–87, <https://doi.org/10.1093/ia/iiz146>.

¹²⁸ United Nations High Commissioner for Refugees, “Mediterranean Situation,” Operational Portal Refugee Situations, April 12, 2021, <https://data2.unhcr.org/en/situations/mediterranean>.

instability of the region.¹²⁹ NATO's Operation Sea Guardian (OSG), launched in November 2016, is a maritime security operations (MSO) initiative that has been conducting three primary tasks: "maritime security capacity building; support to maritime situational awareness; and support to maritime counter-terrorism."¹³⁰ NATO Alliance Maritime Strategy notes that alliance maritime operations will in part include "Conducting surveillance and patrolling, and sharing information thus gathered, in support of law enforcement in the course of, and as part of, their scheduled NATO activities and deployments within the North Atlantic Treaty Area."¹³¹ These NATO forces, specifically, conduct information sharing and provide logistical support to EUNAVFOR Med and Frontex, the EU Border and Coast Guard Agency managing Operation Sophia, the naval operation "aimed to disrupt the business model of migrant smuggling and human trafficking in the Mediterranean."¹³² The challenges faced in Europe are intricately linked with the EU and NATO.

b. The Arctic

American strategic challenges in the Arctic are derived more so from competition over natural resources, the need to uphold freedom of navigation along the North Sea Route (NSR), and the ability to enforce sanctions on Russia.¹³³ The *United States Navy Strategic Outlook for the Arctic* presents the following maritime security challenges facing Arctic operations: "defending sea lines of communication and the homeland from seaborne

¹²⁹ Evmorfia-Chrysovalantou Seiti, "Integrating Maritime Security Operations in the Mediterranean," Center for International Maritime Security, March 28, 2017, <https://cimsec.org/integrating-maritime-security-operations-in-the-mediterranean/>.

¹³⁰ "NATO's Maritime Activities," North Atlantic Treaty Organization, accessed April 18, 2021, http://www.nato.int/cps/en/natohq/topics_70759.htm.

¹³¹ "Alliance Maritime Strategy," North Atlantic Treaty Organization, June 17, 2011, http://www.nato.int/cps/en/natohq/official_texts_75615.htm.

¹³² Giorgia Bevilacqua, "Exploring the Ambiguity of Operation Sophia Between Military and Search and Rescue Activities," in *The Future of the Law of the Sea: Bridging Gaps Between National, Individual and Common Interests*, ed. Gemma Andreone (Cham, Switzerland: Springer International Publishing, 2017), 165–89, https://doi.org/10.1007/978-3-319-51274-7_9.

¹³³ Massimo Deandreis, "Frozen out: Why the EU Needs a Strategy on the Arctic," *European Council on Foreign Relations* (blog), November 17, 2020, <https://ecfr.eu/article/frozen-out-why-the-eu-needs-a-strategy-on-the-arctic/>.

attacks, maritime domain awareness, and supporting Coast Guard operations as required.”¹³⁴ More specifically, the challenges for maritime forces, at least in the near term, are a result of the harsh conditions and operational environment in the high north. A DOD report to Congress identified the following key challenges to Arctic operations: “shortfalls in ice and weather reporting and forecasting; limitations in C4ISR due to lack of assets and harsh environmental conditions; limited inventory of ice-capable vessels; and limited shore-based infrastructure.”¹³⁵ The Hoover Institution expounds upon the issue of the environment, proposing that “Only a small percentage of the Arctic has been surveyed; thus navigation and communications systems, commonplace in other regions of the world, are absent or spotty.”¹³⁶

Communications themselves are further complicated when operating above 70°N. As determined by the DOD, this is the result of “magnetic and solar phenomena that degrade High-Frequency (HF) radio signals, limited surface-based relays outside of Alaska, and geostationary satellite geometry.”¹³⁷ The DOD assesses that the current communications architecture is adequate for single-ship operations, but, “is insufficient to support normal operational practices of a surface action group or any large-scale Joint Force operations.”¹³⁸ To meet the strategic challenges found in the Arctic, the Navy must have the forces and be able to communicate while generating a sound and complete common operational picture (COP) of the area of operations (AO). In summary, the DOD has determined that it requires “the capability to monitor and assess human activity in the Arctic persistently in order to support evolving defense, safety, and security efforts adequately.”¹³⁹

¹³⁴ Chief of Naval Operations, *The United States Navy Strategic Outlook for the Arctic* (Washington, DC: United States Navy, 2019), 12, https://media.defense.gov/2020/May/18/2002302034/-1/-1/1/NAVY_STRATEGIC_OUTLOOK_ARCTIC_JAN2019.PDF.

¹³⁵ Department of Defense, *Report to Congress on Arctic Operations and the Northwest Passage*, 16.

¹³⁶ “The Opening Arctic - Challenges and Opportunities,” Hoover Institution, June 12, 2013, <https://www.hoover.org/events/opening-arctic-challenges-and-opportunities>.

¹³⁷ Department of Defense, *Report to Congress on Arctic Operations and the Northwest Passage*, 16.

¹³⁸ Department of Defense, 16.

¹³⁹ Department of Defense, 16.

The current United States and NATO maritime posture is inadequate, failing to keep pace with Russian naval modernization and “stand-off capabilities designed to challenge the international order at sea.”¹⁴⁰ Discussing the American strategic competitors’ investments in Arctic infrastructure designed to degrade American influence and the rule of law, the United States Coast Guard (USCG) assesses that “this has resulted in a strategic resource gap that threatens the Nation’s ability to effectively uphold sovereignty.”¹⁴¹ A common theme seen both when considering the Mediterranean and Arctic, is a lack of resources and need to maximize efficiency of effort. As stated by Abenheim, et. al., “Americans today have become accustomed to the idea that U.S. military power has unimpeded access to all corners of globe as if such a fact were an eternal right.”¹⁴² Unfortunately this is not a reality, and the need for allies and the inability to go it alone has been brought to the forefront.

3. NATO and the European Union

The importance of NATO and the European Union (E.U.) cannot be understated when considering space cooperation and maritime security throughout the Mediterranean and the Arctic. The U.S. mission to NATO argues that “NATO remains the principal security instrument of the transatlantic community” and that NATO provides “security support” in particular to the E.U.¹⁴³ Furthermore, in November 2019, NATO declared space to be an operational domain, where Defense News reports NATO secretary General Jens Stoltenberg saying “This can allow NATO planners to make requests for allies to provide capabilities and services, such as hours of satellite communications,” and that space is “essential to the alliance’s deterrence and defense, including the ability to navigate,

¹⁴⁰ Colin Barnard, “Improve U.S. Maritime Posture in Europe Through Strategic Realignment,” *Center for International Maritime Security* (blog), January 27, 2021, <https://cimsec.org/improve-u-s-maritime-posture-in-europe-through-strategic-realignment/>.

¹⁴¹ United States Coast Guard, *United States Coast Guard Arctic Strategic Outlook* (Washington, DC: United States Coast Guard, 2019), 24, <https://news.usni.org/2019/04/22/document-coast-guard-arctic-strategic-outlook>.

¹⁴² Abenheim et al., “American Sea Power in the Contemporary Security Environment,” 392.

¹⁴³ “About NATO,” U.S. Mission to the North Atlantic Treaty Organization, accessed April 18, 2021, <http://nato.usmission.gov/our-relationship/about-nato/>.

gather intelligence and to detect missile launches.”¹⁴⁴ In terms of intelligence collection and analysis, much of which is derived from national assets and other space-borne systems, David Weber reports for the Atlantic Council that NATO members frequently share intelligence data and, specifically, “The United Kingdom, France, and Germany alone add 40,000 intelligence personnel to the Alliance’s intelligence capabilities.”¹⁴⁵

The three European countries examined throughout the remainder of this chapter—Germany, France, and the United Kingdom—are all active members of NATO. However, adding further political complexity to the mix, France and Germany remain part of the E.U., while the United Kingdom left the organization as part of the controversial BREXIT, effective January 2020. The withdrawal by the UK, suggests Ana Isabel Xavier, raises questions concerning security and defense and about the UK’s role in the “collective and multilateral efforts within the European Union (EU) and North Atlantic Treaty Organisation (NATO) after Brexit.”¹⁴⁶ As such, any endeavor toward generating an allied space coalition with the UK and other European countries, must account for the organization structure, relationships, and complexities of NATO and the E.U.

B. ALLIES AND REGIONAL PARTNERS: COOPERATION AND CAPABILITIES

Having discussed the strategic challenges and overview of the European AO, this section examines their military space programs and details the space assets, capabilities, and potential for cooperation to be had with Germany, France, and the United Kingdom. In an effort to recognize bias, it is necessary to concede that France receives more attention than Germany or the United Kingdom. This is not intended for any reason other than the lead France holds over its European peers in terms of military space, as well as the larger architecture of military space assets to discuss. Furthermore, the intent is not to cover every

¹⁴⁴ Martin Banks, “NATO Names Space as an ‘Operational Domain,’ but without Plans to Weaponize It,” *Defense News*, November 26, 2019, <https://www.defensenews.com/smr/nato-2020-defined/2019/11/20/nato-names-space-as-an-operational-domain-but-without-plans-to-weaponize-it/>.

¹⁴⁵ David Wemer, “Here’s Why the United States Needs NATO,” *Atlantic Council* (blog), July 5, 2018, <https://www.atlanticcouncil.org/blogs/new-atlanticist/here-s-why-the-united-states-needs-nato/>.

¹⁴⁶ Ana Isabel Xavier, “The Impact of Brexit on Security and Defence Multilateralism: More Cooperation or Overlapping Interests?,” *Marmara Journal of European Studies* 26, no. 1 (2018): 101.

satellite owned or operated by these countries, rather to look at specific military systems that have been developed and have potential to be integrated into an allied space coalition supporting naval operations. To this end, it must be acknowledged that commercial satellites play a predominant role in supplementing military satellite capabilities; however, they too have been withheld from discussion, as they are outside of the scope of military cooperation. Moreover, the intent is to provide evidence to be examined in the following section as to how they could enhance specified naval missions.

1. Germany

Responsibility for the military space domain in Germany falls to the Federal Ministry of Defense. However, different than many other countries, the United States included, *The space strategy of the German Federal Government* states: “in Germany, innovations in the space sector tend to stem mostly from technologies developed for civil and scientific applications,” rather than the military itself as the main driver.¹⁴⁷ All this technology development has led to a reality in which Josué Michels reports “Germany’s space expertise is in spying and surveillance.”¹⁴⁸

Within the German military or Bundeswehr, the Air Force is the branch responsible for space, recently establishing a new Air and Space Operations Centre (ASOC) in November 2020, according to Dominic Vogel, in recognition of “growing military importance of space as an operational dimension.”¹⁴⁹ The Bundeswehr currently has two MILSAT systems directly under its control: the SAR-Lupe system and COMSATBw.¹⁵⁰ The Bundeswehr will also have access to a series of three intelligence satellites, nicknamed project Georg, which the German government has invested 400 million euros (\$465

¹⁴⁷ Federal Ministry of Economics and Technology, *Making Germany’s Space Sector Fit for the Future: The Space Strategy of the German Federal Government* (Berlin, Germany: Federal Ministry of Economics and Technology, 2010), 19.

¹⁴⁸ Josué Michels, “The German Military’s Unnoticed Space Program,” *The Trumpet*, August 27, 2019, <https://www.thetrumpet.com/21159-the-german-militarys-unnoticed-space-program>.

¹⁴⁹ Dominic Vogel, “German Armed Forces Approaching Outer Space: The Air and Space Operations Centre As a Gateway to Multi-Domain Operations,” *German Institute for International and Security Affairs*, October 2020, 1, <https://www.swp-berlin.org/10.18449/2020C49/>.

¹⁵⁰ “Satellite Database,” *Union of Concerned Scientists*, January 1, 2021, <https://www.ucsusa.org/resources/satellite-database>.

million) in service of the Bundesnachrichtendienst (Foreign Intelligence Service).¹⁵¹ In addition to the domestically owned systems, Berlin reached an agreement in April 2015 with the French Space Agency, in which it paid 210 million euros for access rights to imagery from *Composante Spatiale Optique (CSO) 3*, a high-resolution electro-optical reconnaissance satellite.¹⁵²

The SAR-Lupe system was the first dedicated German MILSAT system.¹⁵³ The U.S.'s refusal to share intelligence data with non-U.S. allied forces during the NATO action in Kosovo (1998-1999), motivated Germany to develop its own intelligence capability.¹⁵⁴ In 2000, at the NATO Summit in Prague, Germany committed to the SAR-Lupe project because they felt, as Chris Pocock explains, there were "shortcomings in the alliance's operational capabilities."¹⁵⁵ Shortly after the announcement, in 2002, Germany signed a data-sharing agreement with the French, granting access to SAR-Lupe in exchange for limited access to their complementary system, Helios II optical reconnaissance satellites.¹⁵⁶ The prime contractor for the project, OHB-System AG of Bremen, built ground stations in both France and Germany, part of what the ESA Earth Observation Portal describes as a "bilateral French-German program called E-SGA (Europäisierung der satellitengestützten Aufklärung)," an effort to combine space-based assets of multiple nations into a usable system.¹⁵⁷

The constellation, launched between 2006–2008, is a series of five SAR reconnaissance satellites (*SAR-Lupe 1–5*) with a ten year design life based on a variety of

¹⁵¹ Jefferson Chase, "German Intelligence Agency Gets Spy Satellite System Funds," *Deutsche Welle*, June 11, 2017, <https://www.dw.com/en/german-intelligence-agency-gets-spy-satellite-system-funds/a-41244180>.

¹⁵² "CSO 1, 2, 3," Gunter's Space Page, January 1, 2021, https://space.skyrocket.de/doc_sdat/cso-1.htm.

¹⁵³ Union of Concerned Scientists, "Satellite Database."

¹⁵⁴ "SAR-Lupe," ESA Earth Observation Portal, accessed April 20, 2021, <https://earth.esa.int/web/eoportal/satellite-missions/s/sar-lupe>.

¹⁵⁵ Chris Pocock, "Space Radar - Germany's SAR-Lupe Constellation Puts Europe Ahead," *C4ISR -- The Journal of Net-Centric Warfare*, November 1, 2006.

¹⁵⁶ Sascha Lange, "SAR-Lupe Satellites Launched," *Strategie & Technik-International Edition*, 2007, 3.

¹⁵⁷ ESA Earth Observation Portal, "SAR-Lupe."

factors, including available fuel for onboard hydrazine thrusters, which adjust for altitude decay.¹⁵⁸ ESA Earth Observation Portal provides the following objectives of the system: “event monitoring capability independent of weather and illumination conditions,” assisting the military in operations planning, and support to “deployed forces with frequent event-driven intelligence.”¹⁵⁹ The satellites image in the X-Band (8-12 GHz), with resolution estimated at 0.5-1.0 meter.¹⁶⁰ Operating in LEO orbit with an average altitude of 500 km, and a period of 94.3 minutes, helps the system to achieve greater revisit times.¹⁶¹ SAR-Lupe uses an encrypted S-Band (2-4 GHz) uplink and crosslink to ensure secure data transfer, while using the same antenna for X-Band imaging and data downlink.¹⁶² Writing in *C4ISR-The Journal of Net-Centric Warfare*, Pocock reports the system to be capable of producing greater than 30 images/day with coverage from 80 degrees south to 80 degrees north.¹⁶³ With SAR-Lupe nearing the end of its service life, a follow-on system was developed to provide continuity in coverage. The new system, named SARah, is a series of three, active phased-array SAR satellites that are anticipated to provide greater resolution than the current system.¹⁶⁴ *SARah 1* is expected to be launched by a Space-X Falcon 9 rocket out of Vandenberg AFB, California in October 2021.¹⁶⁵

Following the SAR-Lupe system, the Germans developed a dedicated MILSATCOM capability: the COMSATBw system. Launched in October 2009 and May 2010, *COMSATBw-1* and *COMSATBw-2* are geostationary (i=.05 and .08) communications satellites providing both SHF (3-30 GHz) and UHF (300 MHz- 3GHz)

¹⁵⁸ ESA Earth Observation Portal.

¹⁵⁹ ESA Earth Observation Portal.

¹⁶⁰ Pocock, “Space Radar - Germany’s SAR-Lupe Constellation Puts Europe Ahead.”

¹⁶¹ ESA Earth Observation Portal, “SAR-Lupe.”

¹⁶² ESA Earth Observation Portal.

¹⁶³ Pocock, “Space Radar - Germany’s SAR-Lupe Constellation Puts Europe Ahead.”

¹⁶⁴ “SARah 2, 3,” Gunter’s Space Page, December 2, 2020, https://space.skyrocket.de/doc_sdat/sarah-p.htm.

¹⁶⁵ “Falcon-9 v1.2 (Block 5) (Falcon-9FT (Block 5)),” Gunter’s Space Page, accessed June 5, 2021, https://space.skyrocket.de/doc_lau_det/falcon-9_v1-2_b5.htm.

communication.¹⁶⁶ The satellites are in orbital slots 63 degrees east and 13.2 degrees east, respectively.¹⁶⁷ Airbus Defense and Space has been awarded the contract for on-orbit operation of the satellites and their associated systems through 2022, further describing their capability to provide “military UHF and X-band plus additional capacity in C and Ku-band over a coverage stretching from the Americas to Eastern Asia.”¹⁶⁸ The development and launch of these satellites, at the time, was a milestone for the German Bundeswehr, making them one of five militaries in Europe with a dedicated MILSAT capability.¹⁶⁹

2. France

The French military’s space program traces its roots back to the mid-1980s and the conflict between Chad and Libya. Pressured to intervene in the conflict, based on what French military officers assessed as outdated intelligence, Laurence Nardon describes how this drove the “Prime Minister Laurent Fabius to create a high-level working group to assess the possibility of a French military space program.”¹⁷⁰ The resultant report in 1986, Nardon states “identified space observation as one of the most effective means of gathering information” and, moreover, it “concluded that space observation was just as important for France’s strategic independence as was its nuclear force.”¹⁷¹ In 1992, the Direction du Renseignement Militaire (DRM) or French Military Intelligence Directorate was created, which Gosnold writes combined “the intelligence offices of the navy, army, air force and joint chiefs,” and was tasked “with collecting, analyzing and disseminating military

¹⁶⁶ Union of Concerned Scientists, “Satellite Database.”

¹⁶⁷ Peter B. de Selding, “Germany’s ComsatBw-2 Declared Operational,” SpaceNews, July 9, 2010, <https://spacenews.com/germanys-comsatbw-2-declared-operational/>.

¹⁶⁸ “Airbus Defence and Space Will Operate German Military Satellite System for the next 7 Years,” Airbus, March 9, 2016, <https://www.airbus.com/newsroom/press-releases/en/2016/03/airbus-defence-and-space-will-operate-german-military-satellite-system-for-the-next-7-years.html>.

¹⁶⁹ de Selding, “Germany’s ComsatBw-2 Declared Operational.”

¹⁷⁰ Laurence Nardon, “France Cedes Leading Role in Space to Europe,” *Brookings* (blog), April 1, 2001, <https://www.brookings.edu/articles/france-cedes-leading-role-in-space-to-europe/>.

¹⁷¹ Nardon.

intelligence to the armed forces and political authorities.”¹⁷² Three years later, France launched its first two military and intelligence satellites *Helios 1A* and *Cerise*.¹⁷³ *Helios 1A* remained operational until 2012, when it was removed from service,¹⁷⁴ and *Cerise* holds distinction as the first satellite to be damaged by space debris, one year after achieving orbit, further serving to highlight the importance of redundancy and resiliency in space systems.¹⁷⁵

Recognizing the changing strategic environment and the role of space, France released its first *Space Defence Strategy* in 2019 with the purpose, described by Arthur Laudrain, to help sustain strategic autonomy, improve space situational awareness (SSA) for decisionmakers, and “improve the protection of national and key European space assets.”¹⁷⁶ Derived from the vision established in the *Space Defence Strategy*, France established its own Space Command, the Commandement de l’Espace (CDE) in September 2019.¹⁷⁷ The following September, the integrated French Air and Space Force (Armée de l’Air et de l’Espace) was established, replacing the French Air Force, and in a statement, the new Air and Space Force Chief of Staff Gen. Philippe Lavigne reasoned: “Today aviators must look higher, further, towards space, this new field of confrontation that is highly strategic and increasingly connected.”¹⁷⁸ Murielle Delaporte argues that Paris is keeping with its “determination to, at a minimum, keep its [self-perceived] rank as the third international space power,” hosting its first ever multinational military space exercise,

¹⁷² Gosnold, “History of the French Reconnaissance System,” *SatelliteObservation.Net* (blog), November 6, 2016, <https://satelliteobservation.net/2016/11/06/history-of-the-french-reconnaissance-system/>.

¹⁷³ Gosnold.

¹⁷⁴ “Toutes Les Données Sur Les Satellites,” CNES Multimedia, accessed April 27, 2021, https://www.cnes-multimedia.fr/animations-jeunes/appli_site_cnes/data_en.html.

¹⁷⁵ National Aeronautics and Space Administration, “NASA Space Science Data Coordinated Archive,” April 27, 2021, <https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=1995-033B>.

¹⁷⁶ Arthur Laudrain, “France’s ‘Strategic Autonomy’ Takes to Space,” *IISS Military Balance Blog* (blog), August 14, 2019, <https://www.iiss.org/blogs/military-balance/2019/08/france-space-strategy>.

¹⁷⁷ Christina Mackenzie, “French Air Force Changes Name as It Looks to the Stars,” *Defense News*, September 15, 2020, <https://www.defensenews.com/global/europe/2020/09/15/french-air-force-changes-name-as-it-looks-to-the-stars/>.

¹⁷⁸ Mackenzie.

ASTERX, with Germany, Italy, and the United States in March 2021.¹⁷⁹ Similar to the shift in U.S. space policy toward allied cooperation in 2010, the *French Space Defence Strategy* notes that success of the strategy must be “backed up by an in-depth strategic and political dialogue with our European and transatlantic partners and closer cooperation with our allies.”¹⁸⁰

Reported by the French Office for Science and Technology, Centre National d’Etudes Spatiales (CNES) “is uniquely positioned to serve strategic military needs” as the French space agency and a technical authority.¹⁸¹ The CNES R&T program, under cognizance of the Armed Forces Ministry, helps to develop and improve dual-use earth observation and telecommunication technology, improving military benefits.¹⁸² CNES, through operation of the Ariane launch system, allows France and Europe to maintain an independent launch capability, as well housing the newly established CDE at the Toulouse Space Centre.¹⁸³ The French CDE operates observation, SIGINT, and SATCOM assets to support French military and allied operations.¹⁸⁴ This satellite infrastructure consists of: three earth observation systems: Helios 2, Pléiades, and CSO satellites; two SIGINT systems: ELISA and CERES; and the Syracuse III & IV SATCOM satellites.¹⁸⁵

Satellite observation systems, described by the *French Space Defence Strategy*, provide “non-intrusive intelligence gathering and support for operations and military

¹⁷⁹ Murielle Delaporte, “ASTERX 2021: French Space Forces Reach For Higher ‘Orbit,’” *Breaking Defense* (blog), April 9, 2021, <https://breakingdefense.com/2021/04/asterx-2021-french-space-forces-reach-for-higher-orbit/>.

¹⁸⁰ Space Working Group, *Space Defence Strategy* (Paris, France: Ministry for the Armed Forces, 2019), 26, https://www.defense.gouv.fr/english/layout/set/print/content/download/574375/9839912/version/5/file/%20Space+Defence+Strategy+2019_France.pdf.

¹⁸¹ “CNES in 2021 – An Ambition Serving Citizens Asserting Our Need for Space,” Office for Science & Technology, January 13, 2021, <https://france-science.com/en/cnes-in-2021-an-ambition-serving-citizens-asserting-our-need-for-space/>.

¹⁸² Space Working Group, *Space Defence Strategy*, 43–44.

¹⁸³ Office for Science & Technology, “CNES in 2021 – An Ambition Serving Citizens Asserting Our Need for Space.”

¹⁸⁴ Space Working Group, *Space Defence Strategy*, 17–18.

¹⁸⁵ Space Working Group, 17–18.

geography.”¹⁸⁶ France began with the launch of the Helios program in 1995 with Helios 1A and 1B, which have since been replaced by the second-generation *Helios 2A* and *2B*, in 2004 and 2009.¹⁸⁷ *Helios 2A* operates in a sun-synchronous orbit at 700 km altitude, with two payloads, both an optical imager and infrared imager for nighttime detection.¹⁸⁸ *Helios 2B* is identical to *Helios 2A*. Providing a ground resolution of 35 cm, *Helios 2B* is located in the same near-polar sun-synchronous orbital plane, but separated within the orbit by 180 degrees.¹⁸⁹ Both satellites were multinational projects, including Belgium, Spain, Italy, and Greece, with further bilateral data-sharing agreements signed by Italy and Germany, in exchange for data from COSMO-SkyMed and the SAR-Lupe radar satellites.¹⁹⁰

France’s second satellite observation system, Pléiades, is a dual-use (Civil and Military) two-satellite system with the capability to provide greater than 500 images per day per satellite, in which CNES reports, “it is possible to obtain an image of any point on the planet in less than 24 hours.”¹⁹¹ Launched in 2011, and 2012, both satellites are in a sun-synchronous orbit at an altitude of 694 km, and provide high-resolution imagery (70 cm) in both the visible and near infrared spectrum.¹⁹² Similar to the Helios program, Pléiades was part of a bilateral agreement with Italy, whereby, France developed and funded two optical satellites, Italy developed and funded four X-Band SAR satellites, and the ground segment would be shared amongst the two countries.¹⁹³

¹⁸⁶ Space Working Group, 17.

¹⁸⁷ “Hélios,” Centre National D’études Spatiales, March 5, 2019, <https://helios.cnes.fr/fr/helios>.

¹⁸⁸ Peter B. de Selding, “France’s Helios 2A Recon Satellite Produces First Images,” SpaceNews, January 31, 2005, <https://spacenews.com/frances-helios-2a-recon-satellite-produces-first-images/>.

¹⁸⁹ Peter B. de Selding, “French Helios 2B Spy Sat Sends Back First Test Images,” SpaceNews, January 4, 2010, <https://spacenews.com/32557french-helios-2b-spy-sat-sends-back-first-test-images/>.

¹⁹⁰ “Announcement of the Upcoming Launch of HELIOS 2B Military Observation Satellite,” Defense-aerospace, December 7, 2009, <http://www.defense-aerospace.com/article-view/release/110499/france-to-launch-helios-2b-spy-satellite.html>.

¹⁹¹ Centre National D’études Spatiales (CNES), “Pléiades,” Centre National D’études Spatiales (CNES), accessed May 4, 2021, <https://pleiades.cnes.fr/fr/PLEIADES/Fr/index.htm>.

¹⁹² Centre National D’études Spatiales (CNES).

¹⁹³ “Pleiades,” ESA Earth Observation Portal, accessed May 4, 2021, <https://earth.esa.int/web/coportal/satellite-missions/p/pleiades>.

France's newest and most capable optical reconnaissance satellite, Composante Spatiale Optique (CSO), was developed within the framework of the multinational space-based imaging system (MUSIS), between France, Germany, Belgium, Spain, and Greece in 2008, with the Poles joining in 2010, and a separate bilateral agreement in 2011 with Italy to share CSO and COSMO-SkyMed (CSG) data.¹⁹⁴ The system, when complete, will consist of three LEO satellites, with the first two launched in 2018, and 2020 respectively.¹⁹⁵ CSO-3 has yet to launch, with the launch date being pushed back until at least the second quarter of 2022, a result of the delay in the French Ariane 6 debut.¹⁹⁶ The CSO constellation will differ from previous French systems, as Chris Gebhardt reports, it "will use two different orbital altitudes for the three satellites, with CSO-1 and -3 in 800 km Sun-synchronous orbits while CSO-2 goes into a much lower 480 km Sun-synchronous orbit," which allows for reconnaissance operations and extremely-high-resolution imagery operations, respectively.¹⁹⁷ The three satellites are identical, building on the capabilities of the Pléiades platform, with the greatest resolution images ever produced by a European satellite, which Spaceflight Now reports can achieve resolutions of 35 cm from the 800 km orbit, and better than 20 cm from 480 km altitude.¹⁹⁸ Furthermore, touted by CNES, CSO has "an unprecedented capacity for autonomous orbit control on board for station keeping functions."¹⁹⁹ Airbus Defense and Space has designed and produced the satellites, and will

¹⁹⁴ "Multinational Space-Based Imaging System (MUSIS), Europe - Army Technology," Army Technology, accessed May 4, 2021, <https://www.army-technology.com/projects/multinational-space-based-imaging-system-musis-europe/>.

¹⁹⁵ Centre National D'études Spatiales (CNES), "CSO/Musis," CNES Projects Library, January 4, 2021, <https://cso.cnes.fr/fr/csomusis>.

¹⁹⁶ Chris Gebhardt, "Arianespace, with Russian Soyuz, Launches CSO-2 French Military Satellite," *NASASpaceFlight.Com* (blog), December 29, 2020, <https://www.nasaspaceflight.com/2020/12/arianespace-cso-2-french-satellite/>.

¹⁹⁷ Gebhardt.

¹⁹⁸ Stephen Clark, "French Military Surveillance Satellite Launched by Soyuz Rocket," *Spaceflight Now* (blog), December 29, 2020, <https://spaceflightnow.com/2020/12/29/french-military-surveillance-satellite-launched-by-soyuz-rocket/>.

¹⁹⁹ Centre National D'études Spatiales (CNES), "CSO/Musis."

additionally be responsible for the operation of the ground segment as the prime contractor.²⁰⁰

France is the only country in Europe to experiment with SIGINT detection, currently with the Electronic Intelligence Satellite (ELISA) demonstrator, and seeks to have a domestic capability using the future Capacité de Renseignement Electromagnétique Spatiale (CERES) satellites.²⁰¹ ELISA is a four-microsatellite demonstration system launched in 2011 by the French Directorate General of Armament (DGA), testing technology to detect and precisely locate radar emissions.²⁰² The constellation, located in LEO, is being used to develop the technology for the follow-on LEO constellation, CERES, expected to enter service in 2021.²⁰³ CERES will use a constellation of three satellites in formation to combine signals and precisely locate the detected system.²⁰⁴ Dr. Thomas Withington of Armada International assessed that CERES will be capable of detecting and geolocating signals from 3 MHz to 3 GHz and have further ELINT capabilities between 500 MHz and 40 GHz capable of measuring angle of arrival, pulse width, pulse repetition frequency (PRF), transmission frequency, and the radar's scan rate.²⁰⁵

The final group of military satellites developed by the French is the Syracuse III and IV SATCOM satellites.²⁰⁶ The first two satellites, *Syracuse IIIA* and *IIIB* were launched in 2005 and 2006, respectively, with a design life of 12–15 years.²⁰⁷ There was originally

²⁰⁰ “Airbus-Built CSO-2 French Military Earth Observation Satellite Launched Successfully,” Airbus, December 29, 2020, <https://www.airbus.com/newsroom/press-releases/en/2020/12/airbusbuilt-cso2-french-military-earth-observation-satellite-launched-successfully.html>.

²⁰¹ Centre National D'études Spatiales (CNES), “ELISA,” CNES Projects Library, May 30, 2015, <https://elisa.cnes.fr/fr/elisa>; Space Working Group, *Space Defence Strategy*, 18.

²⁰² Centre National D'études Spatiales (CNES), “ELISA.”

²⁰³ Centre National D'études Spatiales (CNES), “CERES,” CNES Projects Library, March 5, 2019, <https://ceres.cnes.fr/en/ceres-2>.

²⁰⁴ Centre National D'études Spatiales (CNES).

²⁰⁵ Thomas Withington, “French Flare for Space SIGINT,” *Armada International* (blog), July 21, 2019, <https://armadainternational.com/2019/07/french-flare-for-space-sigint/>.

²⁰⁶ Space Working Group, *Space Defence Strategy*, 18.

²⁰⁷ Dee Ann Divis, “US Pushes the Boundaries in Race to Revolutionise Comms in Space,” *Jane's International Defence Review (IDR)*, August 14, 2007, <https://customer-janes-com.libproxy.nps.edu/Janes/Display/idr10784-idr-2007>; Janes, “Second Syracuse Launched,” *Jane's Defence Weekly*, August 21, 2006, <https://customer-janes-com.libproxy.nps.edu/Janes/Display/jdw30272-jdw-2006>.

planned a third Syracuse III, but it was scrapped in favor of hosting the payload on Italy's Sicral 2 satellite, completing the three-satellite Syracuse III constellation.²⁰⁸ *Syracuse IIIA* and *IIIB* are in geostationary orbits, in slots 47 degrees east and 5 degrees west, providing France and allies coverage from the eastern United States to Asia. However, the constellation does not cover the Pacific Ocean.²⁰⁹ The *Syracuse IIIC* payload, hosted on *Sicral 2*, is in a geostationary slot 37 degrees east, over eastern Africa, providing further regional coverage.²¹⁰ The Syracuse system operates in both SHF and EHF bands, and uses internet protocol (IP) for its communications, which is assessed by *Jane's International Defence Review* to "transmit at data rates of up to 400 Mbps in one theatre while maintaining a parallel rate of 70 Mbps in a second theatre, plus other slower communications links."²¹¹ As part of a NATO memorandum of understanding, France, Britain, and Italy agreed to provide SATCOM services for NATO forces from 2005–19, under the NATO SATCOM Post-2000 (NSP2K) program.²¹² France's *Syracuse III* was under contract to provide 45% of secure SHF (7-8 GHz) SATCOM, while Italy's *Sicral 1* and the British *Skynet 4* and *5* would provide additional UHF (300 MHz) and SHF services.²¹³ France, especially the French Navy, began to feel limited in terms of bandwidth, as new technology drove performance requirements and concerns about the harsh operational environment resulted in the contract and development for a transition from Syracuse III to Syracuse IV expected in 2023.²¹⁴ CNES proposes that the new geostationary system will have upgraded resistance to jamming,

²⁰⁸ "Syracuse 3A, 3B, 3C," Gunter's Space Page, July 21, 2019, https://space.skyrocket.de/doc_sdat/syracuse-3.htm; Peter B. de Selding, "Thales Alenia Space, Telespazio To Build Sicral 2 Satellite," SpaceNews, May 7, 2010, <https://spacenews.com/thales-alenia-space-telespazio-build-sicral-2-satellite/>.

²⁰⁹ Peter B. de Selding, "Syracuse 3A Fully Subscribed Only Six Months After Launch," SpaceNews, June 29, 2004, <https://spacenews.com/syracuse-3a-fully-subscribed-only-six-months-after-launch/>.

²¹⁰ Union of Concerned Scientists, "Satellite Database."

²¹¹ Divis, "US Pushes the Boundaries in Race to Revolutionise Comms in Space."

²¹² North Atlantic Treaty Organization, "Satcom Post-2000 (Archived)," North Atlantic Treaty Organization, accessed May 4, 2021, http://www.nato.int/cps/en/natohq/topics_50092.htm.

²¹³ de Selding, "Syracuse 3A Fully Subscribed Only Six Months After Launch."

²¹⁴ "Syracuse III Ground Segment: Helping French Forces Achieve a Big Ambition," Thales Group, accessed August 4, 2019, <http://www.thalesgroup.com/en/worldwide/defence-and-security/references/syracuse-iii-ground-segment-helping-french-forces-achieve>.

more flexibility in its performance, and larger frequency bands (Band X: 8 -12.5 GHz, and Ka band: 26.5 - 40 GHz) to better support the armed forces.²¹⁵

3. United Kingdom

The United Kingdom was the world's third space-faring nation; however, in the last 50 or so years it is unlikely that anyone would still describe the UK as a truly global space power, nor have they launched a satellite independently since 1971.²¹⁶ The British, do however, have a strong and rapidly growing commercial sector,²¹⁷ and hold the claim of being the first nation to successfully deploy a geostationary (GEO) military communications satellite, with *Skynet 1* in 1969.²¹⁸ In recent years, the United Kingdom has begun ramping up its defense spending. As proclaimed by British Prime Minister Boris Johnson: "The international situation is more perilous and more intensely competitive than at any time since the Cold War, and Britain must be true to our history and stand alongside our allies."²¹⁹ The new defense initiative Johnson announced costs 16.5 billion euros (\$22 billion) and will fund a series of future warfare programs, which will include a new Space Command capable of launching the UK's own rocket by 2022. As described by Dr. Bleddyn Bowen of Kings College, the overall "British interest in military spacepower is 'better late than never,'" and as a space power it "sits between its military and intelligence integration with the United States and Five Eyes ..., and industrial and scientific space integration with Europe at both the European Space Agency (ESA) and the European Union (EU)."²²⁰

²¹⁵ "Syracuse 4," Centre National D'études Spatiales (CNES), May 15, 2018, <https://syracuse4.cnes.fr/fr/syracuse-4>.

²¹⁶ Zahaan Bharmal, "Is the UK about to Have Liftoff in the Global Space Industry?," The Guardian, December 31, 2020, <http://www.theguardian.com/science/2020/dec/31/is-the-uk-about-to-have-liftoff-in-the-global-space-industry>.

²¹⁷ Bharmal.

²¹⁸ *Whitehall Papers* "UK Military Space Programmes," 35, no. 1 (January 1996): 30, <https://doi.org/10.1080/02681309609414784>.

²¹⁹ Thomas Brewster, "U.K. Space Force Ready to Launch: Boris Boasts \$22 Billion Boost to Britain's Military Future," Forbes, November 19, 2020, <https://www.forbes.com/sites/thomasbrewster/2020/11/19/uk-space-force-ready-to-launch-boris-boasts-22-billion-boost-to-britains-military-future/>.

²²⁰ Bleddyn E. Bowen, *The Integrated Review and UK Spacepower: The Search for Strategy* (London, UK: Kings College, London, 2020), 4, <https://www.kcl.ac.uk/security-studies/assets/kcl-fasi-british-spacepower-and-the-integrated-review-web4.pdf>.

The newly designated UK Space Command is a joint command which will build upon the existing Royal Airforce (RAF) space organization, and when fully operational will have responsibility and command and control (C2) over all UK space capabilities.²²¹ Working closely with the Space Command is the Ministry of Defense (MOD) Space Directorate, which according to the MOD is responsible for UK “Defence Space policy, strategy and cross-government and international coordination.”²²² Authority and direction will flow from the National Space Council through the Directorate to Space Command, which will delegate to subordinate command elements.²²³ Furthermore, the MOD notes that, as necessary, Space Command will interface with the UK Space Agency “to deliver joint national space capability.”²²⁴

The British have only one major space system on orbit, that provides SATCOM services to the British Armed Forces. As previously mentioned, this system is the Skynet family of satellites, first launched in 1969. Described by Bowen, this “sovereign Skynet military and intelligence satellite” supports the British military, yet its daily operations are “outsourced to Airbus.”²²⁵ At the time of this writing, eight of these satellites remain on orbit, consisting of both Skynet 4 and 5 series. *Skynet 4C*, has drifted into an inclined orbit (13.221 degrees) and is used to provide a few hours coverage daily to British and American Antarctic operations.²²⁶ Three Skynet 4, improved stage two satellites remain operational, detailed by Keith Mitchell as having “nuclear hardening, anti-jamming countermeasures, and

²²¹ “Guidance: UK Space Command,” UK Ministry of Defense, April 1, 2021, <https://www.gov.uk/guidance/uk-space-command>.

²²² UK Ministry of Defense.

²²³ UK Ministry of Defense.

²²⁴ UK Ministry of Defense.

²²⁵ Bowen, *The Integrated Review and UK Spacepower: The Search for Strategy*, 4.

²²⁶ Jonathan Amos, “UK’s Skynet Military Satellite Launched,” BBC News, December 19, 2012, <https://www.bbc.com/news/science-environment-20781625>; UK Space Agency, *UK Registry of Outer Space Objects* (London, UK: UK Space Agency, 2021), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/952990/UK_Registry_of_Space_Objects_January_2021.pdf.

laser protection.”²²⁷ The newest generation, Skynet 5, was launched between 2007–2012, *Skynet 5A-5D*.²²⁸ These satellites provide military users X-band and UHF capacity, with both regional coverage and steerable spot beams.²²⁹ Airbus has marketed these satellites as “Fully interoperable with WGS X-band terminals.”²³⁰ Furthermore, the system is capable of offering “5 UHF channels that are fully coordinated with NATO standards to ensure usability and interoperability.”²³¹ Responding to the growing demand and acknowledgment of future needs, the British MOD signed a 500 million euro contract with Airbus Defense and Space in 2020 to develop a follow-on system extending the Skynet family, starting with *Skynet 6A*, expected to launch in 2025 with a 15-year design life.²³²

In addition to the Skynet communication satellites, the MOD has funded and participated in two development programs for optical reconnaissance satellites: *Carbonite 2* and *TopSat 1*.²³³ Both programs are being coordinated with the UK Space Agency to demonstrate a commercial capability for Earth Observation (EO) that could provide military application. C4ISRNET reports that the British MOD invested 4 million euros (\$5 million) in the program to test “the capabilities of the system to provide reconnaissance video and still imagery.”²³⁴ Describing *Carbonite 2*, British MOD Chief Scientific Advisor Hugh Durrant-Whyte stated: “this is an excellent example of defence science and technology working with industry and the Royal Air Force to deliver affordable and pioneering space

²²⁷ Keith Mitchell, “Skynet: The Real Communication Satellite System,” The National Archives blog (The National Archives, October 24, 2019), <https://blog.nationalarchives.gov.uk/skynet-the-real-communication-satellite-system/>.

²²⁸ UK Space Agency, *UK Registry of Outer Space Objects*, 36–38, 49.

²²⁹ “Skynet 5 X-Band,” Airbus, accessed April 27, 2021, <https://airbus-ds-gs.com/skynet-5-x-band/>.

²³⁰ Airbus.

²³¹ “Skynet 5 UHF,” Airbus, accessed April 27, 2021, <https://airbus-ds-gs.com/skynet-5-uhf/>.

²³² “Airbus Signs Contract with UK Ministry of Defence for Skynet 6A Satellite,” Airbus, July 19, 2020, <https://www.airbus.com/newsroom/press-releases/en/2020/07/airbus-signs-contract-with-uk-ministry-of-defence-for-skynet-6a-satellite.html>.

²³³ “Military Spacecraft - U.K.,” Gunter’s Space Page, accessed April 22, 2021, https://space.skyrocket.de/directories/sat_mil_uk.htm.

²³⁴ Andrew Chuter, “Carbonite-2 Satellite Enters Orbit to Test British Intel-Gathering Capability,” C4ISRNET, January 12, 2018, <https://www.c4isrnet.com/c2-comms/satellites/2018/01/12/carbonite-2-satellite-enters-orbit-to-test-british-intel-gathering-capability/>.

technology quickly for our Armed Forces.”²³⁵ The TopSat, program, similar to Carbonite, was outlined by ESA Earth Observation portal as a demonstration, testing “the capabilities of small spacecraft on a high-resolution imaging mission, including an end-to-end ground segment with services for a commercial user community” by which “the data is also being used by institutional users (government agencies, military, etc.).”²³⁶ Both programs show the British MOD’s political will and desire to continue investing in and to advance space technologies.

C. IMPACT ON NAVAL MISSIONS

With the discussion of select American allies’ military space programs and capabilities conducted in the previous section, this section turns toward their utility and application on maritime operations concerning communications, MDA, and METOC. Specifically, how can an allied space coalition including Germany, France, and the UK assist U.S. naval operations countering maritime terrorism, illegal immigration, and expanded Russian naval operations as described in the beginning of the chapter? In keeping with the scope of this thesis, discussion is constrained to maritime operations, although, many of the systems lend themselves to joint operations.

1. Communications

Considering the applicability of European space systems on communications and U.S. naval operations throughout Europe, there are three benefits to be had: interoperability, resilience, and improved bandwidth. In strategic terms, presented in the Tri-Service Maritime Strategy, interoperability is vital; enables “the development of combined warfighting concepts to counter malign activities, uphold international norms, and contribute to deterrence.”²³⁷ In Europe, this means improving integration with NATO forces to conduct

²³⁵ Ministry of Defense et al., “Lift-off: Satellite Launched into Space on RAF Mission,” UK Ministry of Defense, March 1, 2018, <https://www.gov.uk/government/news/lift-off-satellite-launched-into-space-on-raf-mission>.

²³⁶ “TopSat,” ESA Earth Observation Portal, accessed April 22, 2021, <https://directory.eoportal.org/web/eoportal/satellite-missions/t/topsat>.

²³⁷ Department of the Navy, United States Coast Guard, and United States Marine Corps, *Advantage at Sea: Prevailing with Integrated All-Domain Naval Power*, 23.

exercises and security operations, such as Operation Sea Guardian or Operation Sophia, as part of a larger deterrence campaign focused on Russia. Discussed in Chapter II, communication enables naval forces to transmit orders, direct movement of forces, and coordinate efforts. This enabling capability is precisely what Russian maritime doctrine seeks to disrupt throughout the European AO, with the intent to create a contested, degraded, and operationally limited (CDO) environment. Therein lies the necessity for, and benefit generated from increasing the resiliency of satellite communications. Moreover, adding more satellites to the overall combined force architecture will not only generate resiliency, but will offer opportunities for increased capacity and bandwidth available to the U.S. Navy (USN).

France's Syracuse system and the UK's Skynet system are NATO compatible, and the newest generation Skynet 5 is further marketed as being fully interoperable with the U.S. WGS X-Band terminals. This inherent interoperability amongst allied naval forces will help to ensure uninterrupted communication during exercises and maritime security operations (MSO). Removing the hurdle of interoperability through NATO compatibility and terminal compatibility with U.S. systems serves to provide the USN an option for greater flexibility and ease of access to allied communication networks with coverage throughout the Mediterranean.

Partnership with Germany, France, and the UK can further provide the USN resiliency in terms of European SATCOM coverage. An Air Force Space Command white paper proposes that resiliency is both a function of disaggregation and hardening of the system itself, which "is of value whether the threat is a hostile adversary, or an environmental threat, such as orbital debris."²³⁸ Increasing the pool of satellites used to provide naval SATCOM services will inherently increase the disaggregation of assets, generating greater resiliency. Resiliency, in terms of hardened systems, can also result from allied cooperation.

²³⁸ Air Force Space Command, *Resiliency and Disaggregated Space Architectures* (Colorado Springs, CO: Air Force Space Command, 2013), 3.

The U.S. has increasingly relied upon commercial high-throughput satellite (HTS) networks over the last two decades to meet U.S. DOD communication needs.²³⁹ In 2013, a Defense Business Board (DBB) report found that DOD SATCOM services were comprised of 40% commercial SATCOM, costing \$640 million per year, a trend that was “expected to escalate dramatically in the near future.”²⁴⁰ While reducing cost is important, the vulnerability created by this demand for non-military COMSAT systems is more concerning. That same year, MILSAT systems could not meet the communication needs of U.S. Africa Command, which turned to the commercial sector, signing a one-year \$10 million deal leasing an *Apstar-7* satellite from a Chinese firm, creating a possible security risk.²⁴¹ Granted, this happened to a COCOM, yet the lesson applies all the same to naval forces at large and would hold true during increased maritime demand throughout the Mediterranean. Allied MILSATCOM is an alternative to commercial options that allow for security and resilience. COMSATBw, Syracuse, and Skynet satellites offer anti-jam, anti-laser, and electronically hardened MILSATCOM coverage options to achieve mission assurance for maritime forces in a European CDO environment.

The Office of the Assistant Secretary of Defense for Homeland Defense & Global Security expands on the concept of network resiliency, further proposing the concept of Space Domain Mission Assurance, which is achieved through defensive operations, reconstitution, and resilience.²⁴² Coordination with European allies will help provide for two of the three components: resilience, as discussed previously, and reconstitution. The Center for Strategic and International Studies reported a shortfall in U.S. operational SATCOM

²³⁹ Rick Lober and Rajeev Gopal, “Military Satcom Evolving to Meet Resiliency Requirements,” *SpaceNews* (blog), September 17, 2018, <https://spacenews.com/op-ed-military-satcom-evolving-to-meet-resiliency-requirements/>.

²⁴⁰ Defense Business Board, *Taking Advantage of Opportunities for Commercial Satellite Communications Services* (Washington, DC: Defense Business Board, 2013), 1, <https://doi.org/10.21236/ADA581065>.

²⁴¹ Veronica Magan, “US Military Leases Chinese Satellite Capacity to Provide Bandwidth for Africa Command,” *Satellite Today* 12, no. 85 (April 30, 2013), http://search.proquest.com/docview/1351089199?rfr_id=info%3Axri%2Fsid%3Aprimo.

²⁴² Office of the Assistant Secretary of Defense for Homeland Defense & Global Security, *Space Domain Mission Assurance: A Resilience Taxonomy* (Washington, DC: Office of the Assistant Secretary of Defense for Homeland Defense & Global Security, 2015), 3, <https://fas.org/man/eprint/resilience.pdf>.

systems, in that the average age as of FY2019 was just shy of 12 years.²⁴³ Replacing the aging on-orbit SATCOM systems are two scheduled projects: Protected Tactical Satellite Communications (PTS) and Evolved Strategic Satellite Communications (ESS).²⁴⁴ Neither system is expected to be operational until the mid-to-late 2020s. Interoperable European SATCOM systems, on the other hand, can provide the Navy with SATCOM service coverage in Europe should domestic systems begin to fail, and will assist in solving the challenge of reconstitution as our allies continue expanding and launching their own SATCOM networks, ultimately begetting mission assurance.

In addition to mission assurance and resiliency, allied SATCOM provides an opportunity for increased bandwidth. Stated above, U.S. DOD demand for SATCOM services has been growing rapidly, and military systems cannot meet the demand. The USN is no exception from this trend. By leveraging allied systems, the USN can increase available channels and throughput to ships at sea in the Mediterranean. Skynet 5, for example, is reported by Airbus (formerly EADS Astrium) to have five MILSAT UHF channels available for mobile voice and data needs.²⁴⁵ In 2008, the U.S. contracted with Paradigm (EADS Astrium) to purchase one 155 Mbps by 8 Mbps link—the excess capacity that was unused by the UK MOD.²⁴⁶ Syracuse IV, reported by SpaceNews, is expected on orbit in 2022 and will “offer X-band, military Ka-band and X/Ka dual-band mode services for allied governments at speeds of up to several hundred megabits per second.”²⁴⁷ The new Syracuse satellites will only further deepen the well of available bandwidth and communications available to support European maritime operations. Finally, while the German COMSATBw system does not currently report any excess capacity on its two satellites, it can be expected that any future cooperation and inclusion of Germany in an allied space coalition would allow

²⁴³ Todd Harrison and Seamus P Daniels, *Analysis of the FY 2021 Defense Budget*, Defense 360 (Washington, DC: Center for Strategic and International Studies, 2020), 39.

²⁴⁴ Harrison and Daniels, 48.

²⁴⁵ Airbus, “Skynet 5 UHF.”

²⁴⁶ Andy Stroome, “Skynet 5 Programme Update,” in *2008 IET Seminar on Military Satellite Communication Systems* (London, UK: IEEE, 2008), 4, <https://doi.org/10.1049/ic:20080492>.

²⁴⁷ Jeff Foust, “Airbus and Telespazio to Sell Excess Capacity on Syracuse 4 Satellites,” *SpaceNews* (blog), September 10, 2019, <https://spacenews.com/airbus-and-telespazio-to-sell-excess-capacity-on-syracuse-4-satellites/>.

for relative ease of integration considering that COMSATBw, like the Syracuse systems and the previously contracted Skynet, are all operated by Airbus Defence and Space.²⁴⁸

2. Maritime Domain Awareness

European Earth Observation systems can provide utility to U.S. Sixth Fleet, reducing operational resource constraints and supporting NATO efforts, for example, as part of Operation Sophia or countering the Russian submarine fleet. These systems help build the recognized maritime picture (RMP) essential to MDA. European COMSAT systems, discussed above, also allow the USN to achieve greater resiliency and capacity of communications throughout Europe, which will promote MDA. As Ajey Lele states, “Satellites allow real-time communication which is essential for ship and cargo surveillance, or vessel monitoring.”²⁴⁹ Cooperation with European allies will enhance the command-and-control function required for MDA to be successful.

Communication aside, both active and passive satellite systems enhance maritime surveillance. Lele proposes that “For the purpose of better time and spatial coverage, the best option presently available is the use of space sensors, which are capable of providing global coverage.”²⁵⁰ While true that global coverage is achieved due to the nature of orbits, this chapter is concerned with application of European SIGINT, SAR, and EO/IR systems on MDA in the Mediterranean and Arctic. To this end, of the three allies examined, France and Germany have the market share of Earth Observation systems. France has the largest number of available satellites that can contribute to the mission; however, Germany has a series of extremely high resolution and highly regarded SAR satellites.

Werner Fasslabend, president of the Austrian Institute for European and Security Policy (AIES), articulates in a *Space Policy* article that “threats no longer come only from an armed attack by another state; rather the current concept of ‘functional security’ includes

²⁴⁸ “Military Satellite Communications,” Airbus, accessed May 11, 2021, <https://www.airbus.com/defence/military-satellites.html>.

²⁴⁹ Ajey Lele, *Space and Maritime Security* (New Delhi, India: National Maritime Foundation, 2017), 14.

²⁵⁰ Lele, 22.

threats to the economy, such as the threat posed by piracy to the world's traffic."²⁵¹ Mentioned previously, a RAND study advocates that in the Mediterranean one of the greatest challenges is migration.²⁵² While not entirely similar, piracy, human trafficking, and migrant smuggling activities trend together, which are combated under UNSCR enforcement and NATO cooperation with Operation Sophia, intended to repress transnational criminality.²⁵³ As these transnational challenges continue to grow, space-based sensors can achieve a high impact on naval operations and MDA. Nardon and Venet find that "EO satellites can detect threats in the high seas, including piracy and terrorist activities"; traditionally, however, satellites can have a "mixed record of detecting ships" on account of lower resolution and poor revisit times.²⁵⁴ This has resulted in a need for additional surveillance tools, such as maritime patrol aircraft (MPA), unmanned aerial vehicles (UAVs), or coastal systems.²⁵⁵ In this instance satellites from both France and Germany can reduce the need for USN P-3/P-8 aircraft or surface vessels to be used for the ISR mission. France's *Helios 2A/2B*, *Pléiades 1A/1B*, and CSO satellites, with the German SAR-Lupe constellation, offer an opportunity for 12 high-resolution LEO satellites to support Mediterranean and Arctic MDA. With a larger constellation, greater revisit times can be achieved, nullifying the concerns raised by Nardon and Venet. Moreover, both Helios and SAR-Lupe are equipped with infrared sensors, with Pléiades operating in near IR (subregion of IR spectrum), allowing for continued detection and vessel tracking during inclement weather and at night.

Dr. Steven Goff points out in a USNI article that the Coast Guard, the U.S.'s primary maritime presence in the polar regions, only has two icebreakers (nearing end of lifetime) and that an investment in space-based capabilities could assist in the goal of "ensuring a safe,

²⁵¹ Nina-Louisa Remuss, "Space and Maritime Security—Strategies for Countering the Pirates," *Space Policy* 26, no. 2 (May 1, 2010): 1, <https://doi.org/10.1016/j.spacepol.2010.02.013>.

²⁵² Michael J. McNerney, Giacomo Persi Paoli, and Sarah Grand-Clement, *Cross-Cutting Challenges and Their Implications for the Mediterranean Region*, 3.

²⁵³ Marta Bo, "Fighting Transnational Crimes at Sea under UNSC's Mandate: Piracy, Human Trafficking and Migrant Smuggling," *EJIL: Talk!* (blog), October 30, 2015, <https://www.ejiltalk.org/fighting-transnational-crimes-at-sea-under-unscs-mandate-piracy-human-trafficking-and-migrant-smuggling/>.

²⁵⁴ Nardon and Venet, "The Use of Space for Maritime Security in Europe," 3.

²⁵⁵ Nardon and Venet, 3.

secure, and cooperative Arctic region.”²⁵⁶ Naval operations in the Arctic have also begun to increase, such as the 2020 Barents Sea patrol, which Bryan Clark describes as “an area where Russian submarines like to operate, and we’ve kind of left the area alone for so long that it’s become an extension of the areas they deploy that they [the Russians] see as their bastion.”²⁵⁷ Russian submarine patrols jumped 50% from 2013 to 2014, and by 2017 had reached levels unseen since the Cold War.²⁵⁸ The high-resolution EO/IR satellites of France, and especially the SAR satellites of Germany, can be used to detect surfaced submarines; observe operational changes at submarine bases, improving understanding of deployment patterns and notification of submarines getting underway; and possibly detect a submarine wake as proposed by the Nuclear Threat Initiative.²⁵⁹ French observation satellites are all highly inclined, with near polar orbits, meaning they will provide coverage in the Arctic as well as the Mediterranean. Germany’s SAR-Lupe system is slightly less inclined, yet still provides coverage from 80 degrees South to 80 degrees North, including coverage of the Barents Sea.

Finally, France’s investment in the ELISA demonstrator and future CERES systems will provide further benefit to allied naval operations. These systems can assist the MDA mission by detecting and locating radar emissions through geolocation. Not only will this help commanders to understand where ships are in the environment but, through signal processing, commanders will gain a better understanding of what the ship is or is not. ELINT in conjunction with EO imagery will help to locate and identify smuggling vessels, or locate and track specific Russian submarines, entirely based on signal transmission.

²⁵⁶ Steven Goff, “The U.S. Coast Guard and the U.S. Space Force: An Essential Partnership in Maritime Security,” *USNI* (blog), October 13, 2020, <https://blog.usni.org/posts/2020/10/13/the-u-s-coast-guard-and-the-u-s-space-force-an-essential-partnership-in-maritime-security>.

²⁵⁷ Larter, “The U.S. Navy Returns to an Increasingly Militarized Arctic.”

²⁵⁸ Sam LaGrone, “Russian Navy Chief: Submarine Patrols Up 50 Percent Over Last Year,” *USNI News* (blog), March 19, 2015, <https://news.usni.org/2015/03/19/russian-navy-chief-submarine-patrols-up-50-percent-over-last-year>; Kyle Mizokami, “Russian Subs Are on Patrol Like It’s the Cold War All Over Again,” *Popular Mechanics*, April 3, 2017, <https://www.popularmechanics.com/military/navy-ships/a25919/russian-submarine-patrols-cold-war/>.

²⁵⁹ The Nuclear Threat Initiative, “Submarine Detection and Monitoring: Open-Source Tools and Technologies,” 20 Years of NTI Building a Safer World, March 2, 2021, <https://www.nti.org/analysis/articles/submarine-detection-and-monitoring-open-source-tools-and-technologies/>.

3. Meteorological and Oceanographic Operations

None of the European countries discussed have dedicated military METOC satellites. While allied contributions to naval operations lie more firmly in communication or MDA, this is not to say they cannot have an impact on the METOC mission. Don Conlee and Richard Crout, at an American Meteorological Society conference, described how “synthetic aperture radar (SAR) imagery is extensively used [by the Naval Oceanographic Office (NAVO)] in the production of sea ice analyses in U.S. waters and the Arctic.”²⁶⁰ Through the use of SAR, NAVO can determine ice edge, ice coverage, and ice concentration in all weather conditions, day or night, an arrangement already shown successful through a partnership with Canada and its RADARSAT-1 system.²⁶¹ Germany’s SAR-Lupe can play the same role, providing additional data to NAVO and Navy METOC forecasters supporting the fleet.

Ajey Lele discusses in *Space and Maritime Security*, how “[SAR] images have been used for applications such as wave and wind retrievals, ship detection, monitoring of sea ice, as well as the interpretation of signatures of surface current gradients over oceanic fronts, internal waves, and shallow-water bathymetry.”²⁶² SAR data, through interpretation by NAVO and METOC cells, provides a huge advantage to naval forces, specifically in the Arctic. Satellite navigation through GNSS systems in the Arctic can be limited, a result of orbital inclination limitations on trilateration, and the higher ionospheric activity effect on signal scintillation.²⁶³ With safety of navigation an increased concern, understanding and predicting wind and weather patterns, in addition to changing sea ice conditions, becomes of vital importance for naval operations. Nowhere is oceanographic and bathymetry data more important than when considering Russian submarine activity. Anti-submarine warfare

²⁶⁰ Don T. Conlee and Richard L. Crout, “Satellite Data Utilization by U.S. Navy Meteorology and Oceanography” (Presentation, 11th Conference on Satellite Meteorology and Oceanography, Monona Terrace Convention Center, Madison, Wisconsin, October 16, 2001), 3–4, <https://ams.confex.com/ams/11satellite/webprogram/meeting.html>.

²⁶¹ Conlee and Crout, 4.

²⁶² Lele, *Space and Maritime Security*, 19.

²⁶³ Chantelle Dubois, “The Limits of Satellite Navigation: GPS Challenges in the Arctic - News,” All About Circuits, July 24, 2018, <https://www.allaboutcircuits.com/news/navigating-the-arctic-why-gps-might-fail-you/>.

(ASW) planners rely upon this data for sensor and weapon system performance predictions.²⁶⁴ Considering that Russian doctrine relies heavily upon its submarine force, the impact of SAR-generated data for ASW becomes fairly clear.

D. ALLIANCE STRUCTURE COMPARISON

Section D provides a brief discussion of the three proposed structures for an allied space coalition—bilateral, regional, or global. Moreover, evidence specific to the European countries and how they would impact the three structures is presented. No policy recommendations or conclusions as to the structure for an allied space coalition are offered, as they will be discussed in Chapter V, following the second case study analysis of Asian allies and the influence of China in the broader great power competition.

Historically, U.S. alliances in Europe have been regional or multi-national in nature, emerging from the second World War, with NATO as the standard model.²⁶⁵ However, Goh et al. have identified that there appears to be a divergence from the traditional model, noting the “ongoing rift between the United States and Europe,” where Germany specifically “is more concerned with the future of the regional order in Europe,” as is France, but both hesitate to take the lead in the “post-Atlantic era.”²⁶⁶ Louis Simón, and colleagues have tackled a similar issue, finding that “The regional alliance system [NATO] lost its original sense of purpose and has experienced greater fragmentation.”²⁶⁷ They found that European states began entering smaller bilateral or minilateral agreements that are threat focused, with Eastern and Northern European states concerned with Russia, and the Southern and Western European states struggling with regional instability or terrorism.²⁶⁸

²⁶⁴ Department of the Navy, *Operational Level Integration of METOC Capabilities*, NWP 3-59M (Washington, DC: Department of the Navy, 2013), 59, <https://www.marines.mil/Portals/1/MCWP%203-35.10.pdf>.

²⁶⁵ Luis Simón, Alexander Lanoszka, and Hugo Meijer, “Nodal Defence: The Changing Structure of U.S. Alliance Systems in Europe and East Asia,” *Journal of Strategic Studies* 44, no. 3 (April 16, 2021): 360, <https://doi.org/10.1080/01402390.2019.1636372>.

²⁶⁶ Evelyn Goh and Ryo Sahashi, “Worldviews on the United States, Alliances, and the Changing International Order: An Introduction,” *Contemporary Politics* 26, no. 4 (August 7, 2020): 378, <https://doi.org/10.1080/13569775.2020.1777044>.

²⁶⁷ Simón, Lanoszka, and Meijer, “Nodal Defence,” 362.

²⁶⁸ Simón, Lanoszka, and Meijer, 362.

In a sense, multiple bilateral or smaller minilateral space agreements as described in “Nodal defence: the changing structure of U.S. alliance systems in Europe and East Asia,” would be in keeping with the current trend toward alliance fragmentation in Europe, and likely represents the easiest avenue toward allied space cooperation, as it allows agreements to be tailored specifically to the particular allied nations’ interests. There would be no need to account for political differences amongst coalition nations as has been seen in the past, upending cooperation. The International Institute for Strategic Studies contends, “European military space cooperation has been hindered by disputes over cross-financing and national industrial shares, as well by the high costs involved.”²⁶⁹ The 1998 failure of the Trimilsat project, a joint effort between the British, French, and Germans is a prime example, with the UK withdrawing from the project for those exact reasons.²⁷⁰

The United States Navy could provide our European allies, individually, the benefits of an alliance, overcoming hurdles that might have hindered cooperation in a more expansive structure. Gentoku Toyoma proposes that “making use of allies’ space capabilities can reduce costs,” and “make it less necessary for the United States to build complex space systems because it could employ allies’ capabilities.”²⁷¹ These same benefits of cost saving, and mutual use of capabilities would apply equally, providing additional capability to allies. Furthermore, the Navy, at least when considering operational and tactical uses of allied systems, should not see any loss in terms of added throughput, capabilities, or space-derived data resulting from allied systems, with the assumption that the total number of allies remains the same.

While bilateral agreements are simpler in terms of political hurdles, and in terms of data sharing agreements, they would present a number of significant drawbacks. Two major strategic benefits sought through allied space cooperation are resiliency and deterrence. Minimizing the participants in an allied space structure would significantly reduce disaggregation, distribution, and diversification, which the Office of Assistant Secretary of

²⁶⁹ International Institute for Strategic Studies, “European Military Satellites,” *Strategic Comments* 6, no. 10 (December 1, 2000): 2, <https://doi.org/10.1080/1356788000602>.

²⁷⁰ International Institute for Strategic Studies, 3.

²⁷¹ Toyoma, “Countering Threats in Space Through International Cooperation,” 3.

Defense Homeland Defense & Global Security keys in on as critical components of space system resilience.²⁷² The United States, as the central node in a series of multilateral agreements may retain, to an extent, some aspects of disaggregation, distribution, and diversification. But it will definitely weaken the individual allied navies, which are critical to countering the overall challenges of Europe highlighted in the opening section of the chapter. In regard to the issue of deterrence, without a diversity of nations in the alliance driving up the potential cost of adversary aggression, a satellite or constellation, once seen as an unappealing target, no longer holds such a large opportunity cost when operating in a limited bilateral structure.²⁷³

Erring on the side of status quo, the U.S. could maintain its historical alliance posture in Europe and drive toward a regional allied space coalition. Of course, regional cooperation in Europe is the standard, emerging from joint efforts of European nations, and their transnational agencies such as the EU and ESA. The USN would benefit from being able to draw upon the diverse capabilities each nation brings to the coalition. The evidence from section B, would support this approach. Many of the European space programs themselves are intertwined throughout the region, not to mention combined funding, development, and tasking of the various satellite systems. The European Parliament think tank produced an analysis of the European space sector, with the finding that “Space cooperation in Europe therefore represents a mix of supranational and intergovernmental actors and structures.”²⁷⁴ For example, from the beginning, France’s Helios program was developed and funded jointly by France, Italy, and Spain with a scheme for independent tasking, yet by the early 2000s Helios received nearly 20% joint tasking.²⁷⁵ With the supranational and intergovernmental nature of the European space sector, a *Strategic Comments* article presented the case for a “joint transatlantic intelligence network,” proposing that “NATO standardization agreements

²⁷² Office of the Assistant Secretary of Defense for Homeland Defense & Global Security, *Space Domain Mission Assurance: A Resilience Taxonomy*, 7.

²⁷³ Toyoma, “Countering Threats in Space Through International Cooperation,” 2.

²⁷⁴ Daniel Fiott, European Parliament, and Directorate-General for External Policies of the Union, *In-Depth Analysis: The European Space Sector as an Enabler of EU Strategic Autonomy*, PE 653.620 (Brussels, Belgium: European Parliament Think Tank, 2020), 19, https://op.europa.eu/publication/manifestation_identifier/PUB_QA0320833ENN.

²⁷⁵ International Institute for Strategic Studies, “European Military Satellites,” 1.

on technical formats and interfaces for intelligence, surveillance and reconnaissance (ISR) data exchange” be used as a model.²⁷⁶

Naturally, for the United States, following established NATO standards when structuring a regionally allied space coalition would be of great benefit. Military to military space cooperation in Europe, and the requisite interoperability is already in place, the United States would simply need to “plug in” to the network and formalize the alliance structure. Moreover, by following the NATO standard and building on the military-to-military cooperation already in place, expansion of a regional space coalition structure beyond Germany, France, and the UK would be fairly straightforward. The NATO SATCOM Post-2000 (NSP2K) program is one successful example of this, operating under a Memorandum of Understanding, France, Italy, and Britain provided SATCOM services to NATO from 2000 to 2019.²⁷⁷ In this form of alliance, naval units at sea would retain all the benefits discussed through section C. Additionally, the downside of losing the deterrence factor, a result of segregating the alliance into bilateral agreements, becomes null and void. Joining the capabilities and military constellations of Germany, France, and the UK will inherently increase the opportunity cost and complicate Russian analysis when considering counterspace or ASAT actions to thwart allied efforts.

Of course, no form of allied space coalition is perfect, and a regional structure is no exception, it too will have obstacles to overcome should cooperation persist. Rivalries and political friction amongst member nations can be expected. Additionally, the issue of trust must be considered. How will allies know if the others are sharing space-based asset information in return for their own? In this instance, the friction can be seen between the EU and the British. As the leading EU spacefaring nation, French space policy appears to favor regional cooperation, stating: “Our interests are not limited to French military satellites but may include French commercial satellites, some allied satellites and EU satellites.”²⁷⁸

²⁷⁶ International Institute for Strategic Studies, 3.

²⁷⁷ Andrew Stanniland and Denis Curtin, “An Examination of the Governmental Use of Military and Commercial Satellite Communications,” in *Handbook of Satellite Applications*, ed. Joseph N. Pelton, Scott Madry, and Sergio Camacho-Lara (New York, NY: Springer, 2013), 205, https://doi.org/10.1007/978-1-4419-7671-0_8.

²⁷⁸ Space Working Group, *Space Defence Strategy*, 25.

However, the UK on the other hand, following Brexit may not share this sentiment. Bleddyn Bowen analyzed the rise of EU hard power and their delving into the space domain, finding that the “UK may seek to reduce its dependency on the other [EU] through the pursuit of new defence assets in space,” thereby complicating a regional alliance and perhaps requiring individual bilateral agreements with Britain and France.²⁷⁹

In considering allied space cooperation on the global scale, the fundamentals of the structure are hardly divergent from a regional coalition. The benefits and challenges are similar in context, if not scope. The operational benefits of a regional alliance versus global will only expand as more sensors, data sources, and additional bandwidth become available. Likewise, the factors of deterrence and resiliency, will grow as member states are added to the space coalition. As such, to truly understand and address the difference when considering European allies, between a regionally defined space coalition and a global one, the political will of the three allied countries comes to the front. Of the European allies examined, Germany presents itself as the most regionally focused of the three, with both the UK and France seemingly open to a broader coalition.

Germany, at first appears to have a very Europe-first approach to space, which could heavily favor remaining in a regional structure. A case can be made, however, that Germany would support a larger, even global, allied space coalition under the right circumstances. The German space strategy recognizes that they are a “knowledge society” and that for a “country short of raw materials such as Germany, [knowledge] is a strategic resource.”²⁸⁰ Space-based sensors are a key component to harnessing and transmitting this resource anywhere on the globe. Germany’s space strategy addresses the modern military reliance upon satellites, acknowledging their vital role in allowing Germany “to continue to contribute to international peacekeeping missions and play its proper role in global politics.”²⁸¹ This “proper role” would seem to suggest that Germany is open to the possible expansion of space

²⁷⁹ Bleddyn E. Bowen, “A Familiar Frontier: British Defence Strategy and Spacepower,” *Air and Space Power Review* 22, no. 2 (2019): 9.

²⁸⁰ Federal Ministry of Economics and Technology, *Making Germany’s Space Sector Fit for the Future: The Space Strategy of the German Federal Government*, 7.

²⁸¹ Federal Ministry of Economics and Technology, 18.

cooperation beyond Europe and its heavy involvement in ESA. It recognizes that in confronting the rising global challenges, it is necessary to have a coordinated effort, joining with allies and partners in a “networked security” approach.²⁸² However, stemming from a very utilitarian mindset, a great emphasis would need to be placed on efficiency of spending and development of space networks, as the German space strategy emphasizes “avoidance of duplicate activities and structures” in recognizing constrained budgets.²⁸³ In approaching allied space cooperation with Germany, especially in a global structure, it will be important to remain cognizant that innovation and technology development in the German space sector is not driven by or ultimately prioritized under their military, as it is in the United States, but rather their commercial and civil science sectors.²⁸⁴

France’s 2019 *Space Defence Strategy*, when compared to Germany’s, appears to look favorably upon a more global posture, recognizing the threat to its overseas territories in the Pacific, and Indian Oceans, a result of “changing strategic dynamics” in Asia, Russian moves to “rebuild a zone of influence” in the Mediterranean, and possible conflict in the Arctic, arguing that “space will continue to be one of the cornerstones of our operational capabilities, whether for the purposes of deterrence, support to operations or active space defence.”²⁸⁵ France’s cooperation, while European heavy in the short term, is proposed to expand into the Indo-Pacific with potential partners and allies such as India, Japan, and Australia.²⁸⁶ Yet, while cooperation appears favorable, it is not necessarily assured. French authorities have expressed concern, as Sylvie Matelly explains, regarding the prospect of “weakening France’s strategic autonomy by increasing its already considerable defense dependence on U.S. technologies and capabilities.”²⁸⁷ She also comments that France would

²⁸² Federal Ministry of Economics and Technology, 8.

²⁸³ Federal Ministry of Economics and Technology, 29.

²⁸⁴ Federal Ministry of Economics and Technology, 19.

²⁸⁵ Space Working Group, *Space Defence Strategy*, 22.

²⁸⁶ Space Working Group, 35.

²⁸⁷ Sylvie Matelly, *Defense Innovation and the Future of Transatlantic Strategic Superiority: A French Perspective* (Washington, DC: The German Marshall Fund of the United States, 2018), <https://www.gmfus.org/publications/defense-innovation-and-future-transatlantic-strategic-superiority-french-perspective>.

find itself disadvantaged strategically and shorthanded technologically if it fails to expand cooperation with the United States.²⁸⁸ Matelly concludes that any space cooperation with France will need to find the right balance, allowing for continued French strategic independence, while allowing for the benefit of partnership with American technology and industry.²⁸⁹ While not specific in nature to a global space coalition structure, any expansion of the current French space cooperation, led by the United States and the Navy, could trigger concerns of France's loss of strategic autonomy concerning space.

Britain's evolving national space culture presents an opportunity for allied cooperation in all forms. The United Kingdom has turned around its space program in terms of spending and international engagement over the past decade. It has recognized many of its own shortcomings, especially its inability for self-reliance in space, highlighted by its *Integrated Review of Security, Defence, Development and Foreign Policy*, which states: "The UK nevertheless relies heavily on our allies for access to critical capabilities, such as satellite launch."²⁹⁰ Moreover, rather than simply recognizing its reliance, the UK appears to embrace it and seek to enhance cooperation with allies. With the U.S. Space Command having recently taken over Operation Olympic Defender, a U.S. Strategic Command mission to further allied space cooperation and deterrence, the British were the first to join the coalition, assigning personnel to Vandenberg Air Force Base's Combined Space Operations Center.²⁹¹ In further acknowledgment of support for global operations, confirmed by Airbus, the UK moved the *Skynet 5A* satellite from 6° East to 95° East, a 67,000 km relocation placing the asset over Southeast Asia, reported to "provide protected and secure military satellite communications (Milsatcom) services to allied governments in the Asia-Pacific

²⁸⁸ Matelly, 9.

²⁸⁹ Matelly, 9.

²⁹⁰ HM Government, *Global Britain in a Competitive Age: The Integrated Review of Security, Defence, Development and Foreign Policy*, CCS0221035122 (London, UK: Her Majesty's Stationery Office, 2021), 58, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/969402/The_Integrated_Review_of_Security_Defence_Development_and_Foreign_Policy.pdf.

²⁹¹ Nathan Strout, "Space Command Takes over Operation Olympic Defender," C4ISRNET, May 21, 2020, <https://www.c4isrnet.com/battlefield-tech/space/2020/05/21/space-command-takes-over-operation-olympic-defender/>.

region.”²⁹² This shift can be seen to highlight the British concern and global outlook, similar to that of France, about continued Chinese expansion in the Indo-Pacific and its challenges to the international rules-based order.

In concluding the case study of European allies, and the impact of Russia and its continued incursion throughout the Mediterranean and Arctic, the following chapter shifts its focus Eastward to Asia. Chapter IV will follow a similar format as the preceding chapter, however, addressing the growing Chinese influence in Southeast Asia and the Koreas. The challenges faced by naval forces, and the impact of space-based assets on communications, MDA, and METOC will again be discussed from the perspective of Japan, Korea, and Australia. As was done above, the three proposed alliance structures are examined based on their prospective merit given the politics and context of the Indo-Pacific theatre. With both the European and Asian case studies complete at the end of Chapter IV, the concluding chapter will lay out policy recommendations and the best structural alliance for an allied space coalition given the perspectives, capabilities, and politics of the chosen American allies, and their role in the greater strategic context of global great power competition with Russia and China.

²⁹² “Skynet 5A Satellite Move to Asia-Pacific Complete,” Airbus, September 15, 2015, <https://www.airbus.com/newsroom/press-releases/en/2015/09/skynet-5a-satellite-move-to-asia-pacific-complete.html>.

IV. BUILDING AN ASIAN NETWORK TO SUPPORT NAVAL OPERATIONS

This chapter follows a similar thread as the last. Whereas Chapter III conducted a case-study analysis of Europe, Chapter IV examines the strategic maritime challenges in the Indo-Pacific, centered on great power competition with China and expanding Chinese influence. Thus, this chapter addresses allied cooperation and possible contributions to a space coalition among American Indo-Pacific allies: Japan, Australia, and South Korea. Section C examines how allied satellite systems could be leveraged to improve naval operations throughout Asia. The chapter concludes, in section D, with a discussion of the proposed space alliance structures.

A. STRATEGIC IMPORTANCE

The Indo-Pacific region is of vital economic and geopolitical interest to the United States government and its armed forces. Reaffirmed by both the National Security Strategy and National Defense Strategy, the region constitutes the DOD's priority theater.²⁹³ Assistant Secretary of Defense for Indo-Pacific Security Affairs Randal Schriver stated that for the past 70 years the robust U.S. military presence in the region allowed for greater security and stability, enabling strong economic development.²⁹⁴ Capitalizing on this stability, the Indo-Pacific nations built up their "Blue Economy," participating in shipping, offshore hydrocarbons, coastal tourism, fisheries, and aquaculture.²⁹⁵ The Indo-Pacific now generates \$1.9 trillion in two-way trade for the United States,²⁹⁶ which as Schriver puts it, "leads to a strong economy that protects the American people, supports our way of

²⁹³ *National Security Challenges and U.S. Military Activities in the Indo-Pacific: Hearing Before the Committee on Armed Services, House of Representatives*, House of Representatives, 116th Cong. 1 (2019), n.d., 50, <https://www.congress.gov/116/chrg/CHRG-116hhrg36880/CHRG-116hhrg36880.pdf>.

²⁹⁴ H.R., 50.

²⁹⁵ Jay Benson, "Maritime Security in the Asia-Pacific: Measuring Challenges and Progress," *The Debate* (blog), February 13, 2020, <https://thediplomat.com/2020/02/maritime-security-in-the-asia-pacific-measuring-challenges-and-progress/>.

²⁹⁶ Department of State, *A FREE AND OPEN INDO-PACIFIC: Advancing a Shared Vision* (Washington, DC: Department of State, 2019), 6, <https://www.state.gov/wp-content/uploads/2019/11/Free-and-Open-Indo-Pacific-4Nov2019.pdf>.

life, and sustains U.S. power.”²⁹⁷ Moreover, the U.S. maintains close security ties throughout the region; it is party to five formal defense agreements with Japan, South Korea, the Philippines, Thailand, and Australia.²⁹⁸ U.S. Indo-Pacific strategy promotes allied and partner nation cooperation to uphold a free and open Indo-Pacific, while preserving a rules-based international order and advancing a shared vision.²⁹⁹ However, having risen in influence and regional control over the last two decades, China seeks to advance its own agenda within this new global center of gravity through territorial and maritime revisionism, further generating instability and regional friction.³⁰⁰

1. South China Sea and Taiwan

Naval operations and security concerns of the U.S. and its allies span the breadth of the Western Pacific, challenged by an authoritarian North Korean regime in the seas surrounding the Korean Peninsula, to direct strategic competition with China and concerns over access to the global commons in the South and East China Seas. The U.S. maintains 83,500 servicemembers forward deployed across South Korea and Japan to confront regional and global challenges, and strengthen bilateral cooperation.³⁰¹ However, the major strategic focus of U.S. efforts in the context of great power competition with China lies to the south, centered on the South China Sea (SCS) and Taiwan. For this reason, the proceeding chapter will focus its efforts on examining the impact of cooperation on these two parallel levers of strategic influence.

No region in the Indo-Pacific features greater sovereignty disputes or strategic sway than has emerged amidst the SCS. As highlighted in the second chapter, the SCS is central

²⁹⁷ H.R., 50.

²⁹⁸ Marvin Ott, “The South China Sea in Strategic Terms,” *Asia Dispatches* (blog), May 14, 2019, <https://www.wilsoncenter.org/blog-post/the-south-china-sea-strategic-terms>.

²⁹⁹ Department of State, *A FREE AND OPEN INDO-PACIFIC: Advancing a Shared Vision*, 4.

³⁰⁰ Brahma Chellaney, “The Challenge of Building a ‘Free and Open’ Indo-Pacific Region,” *Konrad Adenauer Stiftung* (blog), January 20, 2020, 1, <https://www.kas.de/de/einzeltitel/-/content/the-challenge-of-building-a-free-and-open-indo-pacific-region>.

³⁰¹ Diana Maurer and Jason Bair, *Burden Sharing: Benefits and Costs Associated with the U.S. Military Presence in Japan and South Korea*, GAO-21-270 (Washington, DC: Government Accountability Office, 2021), 2, <https://www.gao.gov/assets/gao-21-425.pdf>.

to the Chinese economy and national interests, naturally placing the maritime realm front and center. A 2017 RAND study asserts that the SCS has become “the unanticipated focal point of U.S.-Chinese geostrategic rivalry.”³⁰² Marvin Ott contends the most important issue at stake in the SCS is that of respect for a “regional ‘rules-based’ order supported by U.S. power.”³⁰³ In short, continued Chinese territorial expansion and disrespect for international law threaten the global commons. The DOD holds the SCS and greater Indo-Pacific as the “single most consequential region for America’s future.”³⁰⁴ Maintaining freedom of access and freedom of operations for the U.S. Navy throughout the SCS is key to maintaining the global commons; Allies will be more important than ever when facing this challenge.

Addressing key shipping lanes, the DOD notes that “[e]ight of the world’s 10 busiest container ports are in the Asia-Pacific region” and, annually, nearly 30 percent of maritime shipping passes through the SCS— over \$1 trillion in American commerce.³⁰⁵ Furthermore, as of 2014, the Strait of Malacca transports over 15 million barrels of oil daily, with an estimated two-thirds of total global oil shipments passing through the region.³⁰⁶ In addition to economic and energy security concerns, security interests are influenced by the twelve major cable systems routed through the South China Sea, connecting Asia to the Middle East, Europe, and America.³⁰⁷ In a report to Congress, Admiral Davidson describes how submarine cables “carry an estimated 95–99% of data, worldwide, which supports global commerce, banking, telecommunications, and

³⁰² James Dobbins et al., *Conflict with China Revisited: Prospects, Consequences, and Strategies for Deterrence*, PE-248-A (Santa Monica, CA: RAND, 2017), 4, <https://www.rand.org/pubs/perspectives/PE248.html>.

³⁰³ Ott, “The South China Sea in Strategic Terms.”

³⁰⁴ Department of Defense, *The Department of Defense Indo-Pacific Strategy Report: Preparedness, Partnerships, and Promoting a Networked Region*, 0–1C9F36A (Washington, DC: Department of Defense, 2019), 1, <https://media.defense.gov/2019/Jul/01/2002152311/-1/-1/1/DEPARTMENT-OF-DEFENSE-INDO-PACIFIC-STRATEGY-REPORT-2019.PDF>.

³⁰⁵ Department of Defense, *The Asia-Pacific Maritime Security Strategy: Achieving U.S. National Security Objectives in a Changing Environment*, F-79748EF (Washington, DC: Department of Defense, 2016), 1, https://dod.defense.gov/Portals/1/Documents/pubs/NDAA%20A-P_Maritime_Security_Strategy-08142015-1300-FINALFORMAT.PDF.

³⁰⁶ Department of Defense, 1.

³⁰⁷ H.R., 117.

more.”³⁰⁸ These cables present a vulnerability, running near Chinese military outposts in the Spratly Islands, with many of the cables maintaining terrestrial cable landing points in mainland China.³⁰⁹ Admiral Davidson notes that global financial and business centers would see massive interruption in data flows should the cables be disturbed.³¹⁰ However, more concerning is the fact that the interception of data or full outage could also impact the U.S. military, in which the Admiral stated: “[T]he military uses some of these same carrier systems. While we have backup systems available, the impacts to efficient and timely decision making would likely be severe.”³¹¹

Eli Huang argues that “China’s cable strategy holds serious security implications for the U.S., Taiwan and the Asia–Pacific community.”³¹² Beijing’s military and Ministry of Information have developed their submarine cable technology since the 1990s, and have recently taken advantage of the advances by installing optical cable systems on Fiery Cross Reef, Subi Reef and Mischief Reef (Spratly Islands), greatly enhancing South China Sea command and control.³¹³ Undersea cables are part of Beijing’s regional strategy, both by focusing on maintaining its media influence and psychological operations, crucial to the Belt and Road Initiative (BRI), and by creating an underwater sensor and cable network for anti-submarine warfare—an “underwater great wall.”³¹⁴

While it is well understood that the SCS is the central focal point of the region for the U.S., Taiwan remains of major strategic importance. Many top analysts suspect a breakdown in cross-strait relations could lead a U.S.-China confrontation.³¹⁵ Lindsay

³⁰⁸ H.R., 117.

³⁰⁹ H.R., 117.

³¹⁰ H.R., 117.

³¹¹ H.R., 117.

³¹² Eli Huang, “China’s Cable Strategy: Exploring Global Undersea Dominance,” *The Strategist* (blog), December 4, 2017, <https://www.aspistrategist.org.au/chinas-cable-strategy-exploring-global-undersea-dominance/>.

³¹³ Huang.

³¹⁴ Huang.

³¹⁵ Lindsay Maizland, “Why China-Taiwan Relations Are So Tense,” Council on Foreign Relations, May 10, 2021, <https://www.cfr.org/backgrounder/china-taiwan-relations-tension-us-policy>.

Maizland writes “the PLA has made preparing for Taiwan contingency [sic] one of its top priorities, and Taiwan has been a major catalyst for China’s military modernization.”³¹⁶ Remaining as the last major historical territory of China, separated from the mainland’s rule, Taiwan is a constant reminder of China’s “century of humiliation,” in which the great empire was forced to surrender territory.³¹⁷ This reminder, argues Maizland, has forced Chinese President Xi Jinping to the belief that “unification with Taiwan is essential to achieving what he calls the Chinese Dream, which sees China’s great-power status restored by 2049.”³¹⁸

In 1954, nearly coming to the brink of nuclear war, the U.S. began its defense relationship with Taiwan by signing a mutual defense treaty.³¹⁹ The treaty was dissolved, however, in 1980, and replaced by the Taiwan Relations Act (TRA), after which, argues Alexander Chieh-cheng Huang, “the security relationship between the United States and Taiwan consequently turned into a unique – and unofficial – one.”³²⁰ The TRA states that the U.S. considers “any effort to determine the future of Taiwan by other than peaceful means, including by boycotts or embargoes, a threat to the peace and security of the Western Pacific area and of grave concern to the United States.”³²¹ This is the situation we find ourselves in today, as described by Doug Bandow—an era of “strategic ambiguity.”³²²

Highlighted recently in auto manufacturing shortages, Taiwan has an impressive technological base and is recognized as the world’s top manufacturer of semiconductor

³¹⁶ Maizland.

³¹⁷ Doug Bandow, “Should We Go to War for Taiwan?,” Cato Institute, April 15, 2021, <https://www.cato.org/commentary/should-we-go-war-taiwan>.

³¹⁸ Maizland, “Why China-Taiwan Relations Are So Tense.”

³¹⁹ Gordon H. Chang, “To the Nuclear Brink: Eisenhower, Dulles, and the Quemoy-Matsu Crisis,” *International Security* 12, no. 4 (Spring 1988): 96–101.

³²⁰ Alexander Chieh-cheng Huang, “The United States and Taiwan’s Defense Transformation,” *Brookings* (blog), February 16, 2010, <https://www.brookings.edu/opinions/the-united-states-and-taiwans-defense-transformation/>.

³²¹ Huang.

³²² Bandow, “Should We Go to War for Taiwan?”

chips.³²³ If China were to cut off Taiwan, it could stem the flow of oil to U.S. allies, take charge of advanced technology, and truly become a Pacific power able to leverage its new status, in order to, as Chris Horton writes, “demand the closure of U.S. military bases in [Japan and South Korea].”³²⁴ Maintaining a free and open Indo-Pacific is not only vital in the case of Taiwan, but for U.S. interests throughout the region and the wellbeing of America’s closest allies. China’s naval modernization and development of what is becoming a blue-water navy, poses the first true challenge to U.S. Navy control in the Western Pacific since the end of the Cold War.³²⁵ Ultimately, what has emerged, proposes Bill Hayton, is “a battle between American demands for access to the ‘global commons’ and China’s search for security. It’s a struggle that will define the future of Asia, and possibly beyond.”³²⁶

2. Maritime Challenges

As Brahma Chellaney contends, U.S. strategic objectives in the region are clear: “build a pluralistic, rules-based Indo-Pacific order, free of coercion and with unhindered freedoms of navigation and overflight.”³²⁷ Maritime forces seeking to uphold the rule of law face many of the same day-to-day challenges as their counterparts in the Mediterranean, such as piracy, illicit trafficking, violent extremist groups, illegal wildlife trade, and unregulated fishing.³²⁸ What sets this theater apart, however, and the more strategically significant challenges, such as China’s “salami-slicing” and grey zone tactics, coupled with Beijing’s A2/AD strategy.

³²³ Maizland, “Why China-Taiwan Relations Are So Tense.”

³²⁴ Chris Horton, “Taiwan’s Status Is a Geopolitical Absurdity,” *The Atlantic*, July 8, 2019, <https://www.theatlantic.com/international/archive/2019/07/taiwans-status-geopolitical-absurdity/593371/>.

³²⁵ John Robert Wood, “China’s Maritime Strategy and National Security in the South China Sea,” *Intelligence and National Security* 36, no. 3 (April 16, 2021): 444, <https://doi.org/10.1080/02684527.2019.1620548>.

³²⁶ Bill Hayton, *The South China Sea: The Struggle for Power in Asia* (New Haven and London: Yale University Press, 2014), 211, Google Books.

³²⁷ Chellaney, “The Challenge of Building a ‘Free and Open’ Indo-Pacific Region,” 16.

³²⁸ Benson, “Maritime Security in the Asia-Pacific.”

Salami-slicing tactics are used by China both in the maritime realm, and along its western border disputes with India. Srimi Sitaraman describes the tactic from the perspective of India, where China begins “gradually occupying contested territory and offering a *fait accompli* to its Indian counterpart, at which point India has to either accept the new territorial status-quo or militarily confront a larger and economically well-resourced country.”³²⁹ Considering the maritime realm, argues Sitaraman, it is “[a] strategy that China has honed in the South China Sea without significant pushback from the ASEAN countries, with the exception of Vietnam.”³³⁰ These tactics are coupled, finds a RAND study, with “China’s unique brand of gray zone measures,” massing and using maritime militia forces, fishermen, and the Chinese coast guard to swarm vessels and “assert administrative control over disputed island features and the maritime zones that those features create.”³³¹

Robert Gold contends that this strategy in the SCS is a means of delegitimizing competitors, through lawfare.³³² Beijing claims features within its maritime sphere, using language of the UN Convention of the Law of the Sea (UNCLOS), ultimately placing China at odds with many of its neighbors, like Japan and the Philippines.³³³ China uses the features to enhance its own regional maritime security efforts, to the detriment of its neighbors, and the U.S. Navy. It has militarized disputed features in the SCS through the installation of coastal defense cruise missiles (CDCM), long-range surface-to-air missiles, and other military outposts.³³⁴ Supporting this notion, Abenheim et al. argue that “China’s strategic interests in its own adjoining seas involve territorial disputes and a desire for a

³²⁹ Srimi Sitaraman, “China’s Salami Slicing Tactics and the Latest India-China Border Standoff,” *Security Nexus* 21 (May 2020): 1, https://apcss.org/wp-content/uploads/2020/06/N2502_Sitaraman_Salami_Slicing_China.pdf.

³³⁰ Sitaraman, 4.

³³¹ Lyle Morris et al., *Gaining Competitive Advantage in the Gray Zone: Response Options for Coercive Aggression Below the Threshold of Major War* (RAND Corporation, 2019), 27–28, <https://doi.org/10.7249/RR2942>.

³³² Robert F. Gold, “Chinese Soft Power: Creating Anti-Access Challenges in the Indo-Pacific,” *Military Review* 100, no. 6 (December 2020): 104.

³³³ Gold, 104.

³³⁴ H.R., 51.

strategic buffer in the maritime sphere.”³³⁵ Ultimately, as Bharat Karnad describes, the militarization of these features is “part of its A2/AD (anti-access/area denial) strategy.”³³⁶ Its strategy is designed to deny and degrade the ability of allied maritime forces to enter and operate in a given environment, through the threat of cruise and ballistic missiles such as the DF-21D, and long-range bombers and surface combatants equipped with long-range anti-ship missiles, such as the YJ-12 or YJ-18.³³⁷

The primary means of countering excessive Chinese claims, both in terms of Taiwan and the SCS, is Freedom of Navigation Operations (FONOPS), evidenced by over 28 challenges across 19 different nations in 2020.³³⁸ FONOPS seek to challenge excessive claims through presence operations that normalize international law: in particular, UNCLOS. A statement seen frequently, in this case from the Department of State’s (DoS) Indo-Pacific vision, punctuates this point: “U.S. forces continue to fly, sail, and operate wherever international law allows.”³³⁹ The United States, Craig Snyder notes, “has so far remained neutral with regard to the various sovereignty claims,” simply seeking to uphold the rule of law and maintain freedom of navigation throughout the global commons.³⁴⁰ Additionally, regional naval exercises promoting allied cooperation and interoperability are conducted to further U.S. regional leadership, such as the recent trilateral naval exercise held in the SCS in October, 2020, between the U.S. Navy, Royal Australian Navy (RAN),

³³⁵ Abenheim et al., “American Sea Power in the Contemporary Security Environment,” 399.

³³⁶ Bharat Karnad, “China Narrows the South China Sea,” *Policy Forum* (blog), August 26, 2016, <https://www.policyforum.net/china-narrows-south-china-sea/>.

³³⁷ Mike Yeo, “China’s Missile and Space Tech Is Creating a Defensive Bubble Difficult to Penetrate,” *Defense News*, June 1, 2020, <https://www.defensenews.com/global/asia-pacific/2020/06/01/chinas-missile-and-space-tech-is-creating-a-defensive-bubble-difficult-to-penetrate/>; Timothy M. Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defeating Aggression?*, RR1820 (Santa Monica, CA: RAND, 2017), 75, https://www.rand.org/pubs/research_reports/RR1820.html.

³³⁸ Geoff Ziezulewicz, “US Military Challenged Fewer Maritime Claims with FONOPS in FY 2020,” *Navy Times*, March 10, 2021, <https://www.navytimes.com/news/your-navy/2021/03/10/us-military-conducted-fewer-fonops-in-fy-2020/>.

³³⁹ Department of State, *A FREE AND OPEN INDO-PACIFIC: Advancing a Shared Vision*, 22.

³⁴⁰ Craig Snyder, “Maritime Security in the South China Sea,” *Journal of Conflict Studies* 24, no. 1 (June 1, 2004), <https://journals.lib.unb.ca/index.php/JCS/article/view/293>.

and Japan Maritime Self Defense Force (JMSDF).³⁴¹ U.S. Navy Task Force 70 reports the exercise was designed to enhance the “collective ability to maintain maritime security and readiness to respond to any regional contingency,” while contributing to a “shared commitment to the security, stability and prosperity of the Indo-Pacific region.”³⁴²

B. ALLIES AND REGIONAL PARTNERS: COOPERATION AND CAPABILITIES

The ensuing subsections will explore the military space programs of U.S. regional allies: Japan, Australia, and South Korea. As before, not every facet each country’s space program is discussed, only those that have the potential for integration into an allied space coalition that favors maritime operations. It is worth noting that compared to their European counterparts, the military space programs of U.S. allies in Asia are still considered relatively nascent in nature, except for Japan.

1. Japan

James Clay Moltz argues in *Asia’s Space Race*: “Japan has long been the most accomplished space power in Asia.”³⁴³ This holds true of U.S. Asian allies today, despite Japan’s original interpretation of the 1967 Outer Space Treaty as non-military, rather than the more prevalent interpretation of non-aggressive.³⁴⁴ In a similar fashion as shortfalls in intelligence during the Gulf War spurred on the French military space program, the North Korean launch of a Taepodong missile, over Japan in August 1998 highlighted Japan’s domestic need for intelligence satellites.³⁴⁵ Jeffrey Richelson notes that the Japanese SDF had received warning of the launch from U.S. national technical assets, but “not as

³⁴¹ Task Force 70 Public Affairs, “U.S., Japan, Australia Conduct Trilateral Naval Exercises in South China Sea,” Commander, U.S. Pacific Fleet, October 19, 2020, <https://www.cpf.navy.mil/news.aspx/130753>.

³⁴² Task Force 70 Public Affairs.

³⁴³ James Clay Moltz, *Asia’s Space Race: National Motivations, Regional Rivalries, and International Risks* (New York: Columbia University Press, 2012), 43.

³⁴⁴ Saadia M. Pekkanen, “Japan’s Space Power,” *Asia Policy* 15, no. 2 (April 2020): 29–30.

³⁴⁵ Jeffrey T. Richelson, “The Whole World Is Watching,” *Bulletin of the Atomic Scientists* 62, no. 1 (January 1, 2006): 31, <https://doi.org/10.2968/062001010>.

promptly as they [Japan] would have liked.”³⁴⁶ This was, Richelson states, “particularly galling for a nation as proud of its technical prowess as Japan.”³⁴⁷ This perceived intelligence gap led to the development of Japan’s intelligence-gathering satellites (IGS), first launched in 2003, a move that was defended as upholding the Diet’s 1969 resolution of peaceful use of outer space due to the “dual-use” nature of the satellites and the entirely non-offensive nature of the assets.³⁴⁸ Up until this point, describes Lionel Fatton, “Japanese dependence on the United States in this domain [space] has been at least as important as in the conventional domains of warfare.”³⁴⁹

Japan’s non-military space posture changed in 2008 when the Japanese Diet approved Japan’s Basic Space Law, establishing the Strategic Headquarters for Space Development, centralizing Japanese space policy, and acknowledging, as stated by Robert Wilson, “that Japan needed to begin using space for national security purposes.”³⁵⁰ Lionel Fatton notes that even with the shift, Japan continues to maintain its non-offensive posture in space and is focused on “military-grade intelligence and early-warning satellites,” a posture that was expanded, in Japan’s 2013 National Security Strategy (NSS), to include MDA, communications, positioning, navigation and timing (PNT) and space situational awareness (SSA).³⁵¹ The 2008 amendment, however, was not the first incident of Japan’s space policy shifting towards a more military focus.

Japan has recognized the changing threats in space, due in part, as Mari Yamaguchi highlights, to the fact that “China and Russia are seeking ways to interfere, disable or

³⁴⁶ Richelson, 31.

³⁴⁷ Richelson, 31.

³⁴⁸ Lionel Fatton, *Japan’s Space Program: Shifting Away from “Non-Offensive” Purposes?*, Notes de l’Ifri, Asie.Visions, 115 (Paris, France: French Institute of International Relations, 2020), 14, <https://www.ifri.org/en/publications/notes-de-lifri/asie-visions/japans-space-program-shifting-away-non-offensive-purposes>.

³⁴⁹ Fatton, 11.

³⁵⁰ Robert S. Wilson, *Japan’s Gradual Shift Toward Space Security*, OTR202000527 (El Segundo, CA: Center for Space Policy and Strategy, 2020), 3, https://aerospace.org/sites/default/files/2020-05/Wilson_JapansGradualShift_20200428_0.pdf.

³⁵¹ Fatton, *Japan’s Space Program*, 15–16.

destroy satellites.”³⁵² As such, under the Japanese Air Self-Defense Force, a new Space Operations Squadron was established in May 2020, intended to reach full operational capability (FOC) in 2023.³⁵³ The unit will be primarily responsible for monitoring spacecraft and SSA operations. Domestically, the unit will coordinate with Japan Aerospace Exploration Agency (JAXA), but it is also part of an effort to expand international cooperation, which, as Prime Minister Shinzo Abe announced, will work with counterparts in the U.S. Space Command.³⁵⁴ In addition to the new Space Operations Squadron, the Ministry of Defense is responsible overall for space capabilities of the Japanese SDF, communication satellites and SSA (Space Operations Squadron); the Cabinet Satellite Intelligence Center is responsible for intelligence satellites; the Cabinet Office also manages and operates the Quasi-Zenith Satellite System (QZSS); and, finally, JAXA is the principle civil space agency responsible for coordination with the MOD and Cabinet, while leveraging the country’s vast technological base.³⁵⁵ The overall military satellite architecture managed across these institutions consists of eight earth-observation satellites,³⁵⁶ two communication satellites,³⁵⁷ and four QZSS satellites.³⁵⁸

In total, Japan has launched 18 IGS satellites since 2003, responding to Kim Jon Il’s missile test a few years earlier.³⁵⁹ Currently on-orbit, according to Lionel Fatton, are

³⁵² Mari Yamaguchi, “Japan Launches New Unit to Boost Defense in Space,” Defense News, May 18, 2020, <https://www.defensenews.com/global/asia-pacific/2020/05/18/japan-launches-new-unit-to-boost-defense-in-space/>.

³⁵³ Yamaguchi.

³⁵⁴ Mari Yamaguchi, “Japan Reveals Plan for Space Defense Unit,” Defense News, January 21, 2020, <https://www.defensenews.com/space/2020/01/21/japan-reveals-plan-for-space-defense-unit/>.

³⁵⁵ Robert Farley, “Managing the Military Problem of Space: The Case of Japan,” The Diplomat, April 23, 2021, <https://thediplomat.com/2021/04/managing-the-military-problem-of-space-the-case-of-japan/>; Wilson, *Japan’s Gradual Shift Toward Space Security*, 4.

³⁵⁶ “Satellite Database.”

³⁵⁷ National Space Policy Secretariat, *Outline of the Basic Plan on Space Policy (Provisional Translation)* (Tokyo, Japan: Cabinet Office, 2020), 6, https://www8.cao.go.jp/space/english/basicplan/2020/abstract_0701.pdf.

³⁵⁸ “Overview of the Quasi-Zenith Satellite System (QZSS),” Cabinet Office: National Space Policy Secretariat, accessed July 8, 2021, https://qzss.go.jp/en/overview/services/sv01_what.html.

³⁵⁹ Melissa Maday, “Japan Successfully Launches Latest IGS Reconnaissance Satellite,” SpaceWatch, February 10, 2020, <https://spacewatch.global/2020/02/japan-successfully-launches-latest-igs-reconnaissance-satellite/>.

“four radar IGSs (plus one spare) and three optical IGSs.”³⁶⁰ Recognizing the need for reconnaissance satellites, Takuya Wakimoto contends long-term Japanese security needs will require “a total of ten IGSs, including four optical, four radar, and two communication (for data-relay) satellites,”³⁶¹ a position which is supported in Japan’s newest Basic Plan on Space Policy, released in June 2020.³⁶²

Keeping with its theme of non-offensive use of space, the Japanese Cabinet Intelligence Center uses the IGS constellation to collect earth observation data which is distributed to the MOD for national security purposes, in addition to other government bodies responsible for natural disaster prevention and response.³⁶³ The Japanese defense space program draws heavily on its strong technological and industrial base, as Mitsubishi is the prime contractor for all IGS satellites, produced by Mitsubishi Electric and launched by Mitsubishi Heavy industries.³⁶⁴

IGS Optical 5–7, launched by Mitsubishi H-IIA rockets in 2015, 2018, and 2020, are Japan’s third generation optical reconnaissance satellites, with an assessed resolution of greater than 40 centimeters (16 in.), based on data from a 2013 prototype mission.³⁶⁵ The three optical satellites are maintained in LEO, with a nearly circular orbit, ranging from 485–511 km in altitude.³⁶⁶ As might be expected, with inclinations between 97.20° and 97.50°, the constellation is sun-synchronous, with periods of roughly 95 minutes each,³⁶⁷ ensuring high revisit times and near global coverage. Additionally, the Cabinet Intelligence Center manages five remote-sensing radar satellites: *IGS Radar 3–6* and an

³⁶⁰ Fatton, *Japan’s Space Program*, 19.

³⁶¹ Takuya Wakimoto, “A Guide to Japan’s Space Policy Formulation: Structures, Roles and Strategies of Ministries and Agencies for Space,” *Issues & Insights* 19, no. WP 3 (April 2019): 6, https://pacforum.org/wp-content/uploads/2019/04/issuesinsights_Vol19WP3_0.pdf.

³⁶² National Space Policy Secretariat, *Outline of the Basic Plan on Space Policy (Provisional Translation)*, 5.

³⁶³ Wakimoto, “Issues & Insights Vol. 19, WP3 – A Guide to Japan’s Space Policy Formulation,” 6.

³⁶⁴ William Graham, “Japanes H-IIA Lofts IGS Optical-5 Satellite,” *NASASpaceFlight* (blog), March 25, 2015, <https://www.nasaspaceflight.com/2015/03/japanese-h-ii-a-igs-optical-5-satellite/>.

³⁶⁵ Graham.

³⁶⁶ Union of Concerned Scientists, “Satellite Database.”

³⁶⁷ Union of Concerned Scientists.

un-numbered radar spare.³⁶⁸ The first two, second generation satellites, launched in 2011 and 2013, were followed by the on-orbit spare in 2015.³⁶⁹ The newer, third generation, reconnaissance satellites, *IGS Radar 5* and *6*, were launched in 2017 and 2018.³⁷⁰ Similar to the IGS Optical series, the IGS Radar satellites are also a sun-synchronous LEO constellation, with the same range of inclinations and same average period of 95 minutes.³⁷¹ The IGS Radar constellation has a reported resolution nearing 1 meter (39.37 inches).³⁷² Overall, however, compared to allied European systems such as France's Helios satellites, or the German SAR-Lupe system, little information on the IGS system has been released to the public.

Japan's newest series of satellites, the Kirameki (DSN) satellites, are the first purpose-built system strictly for the MOD. The first of the three X-Band satellites, launched in 2017, is *Kirameki-2*, which Anushree Dutta notes "precedes that of the Kirameki-1, which [was] undergoing repair after it was damaged during transportation to a launch site in French Guiana in South America."³⁷³ In 2018, following repairs, *Kirameki-1 (DSN-1)* was launched as a hosted payload onboard the commercial *Superbird-8* satellite.³⁷⁴ *Kirameki-3* is expected to be launched in 2022.³⁷⁵ The satellites are maintained in geo-stationary orbit³⁷⁶ with a design life of 15 years that,³⁷⁷ Lionel Fatton writes, will "reinforce interoperability between the three SDF services" and "project power

³⁶⁸ Union of Concerned Scientists.

³⁶⁹ "IGS-Radar 3, 4, 5, 6, 7, 8, Spare," Gunter's Space Page, May 10, 2020, https://space.skyrocket.de/doc_sdat/igs-radar-3.htm.

³⁷⁰ Union of Concerned Scientists, "Satellite Database."

³⁷¹ Union of Concerned Scientists.

³⁷² Gunter's Space Page, "IGS-Radar 3, 4, 5, 6, 7, 8, Spare."

³⁷³ Anushree Dutta, "Implications of Japan's First Military Communication Satellite Kirameki-2," *Indian Defence Review* (blog), March 12, 2017, <http://www.indiandefencereview.com/implications-of-japans-first-military-communication-satellite-kirameki-2/>.

³⁷⁴ "DSN 1 / Superbird 8 (Kirameki 1 / Superbird B3)," Gunter's Space Page, April 6, 2018, https://space.skyrocket.de/doc_sdat/dsn-1_superbird-8.htm.

³⁷⁵ Wilson, *Japan's Gradual Shift Toward Space Security*, 12.

³⁷⁶ Union of Concerned Scientists, "Satellite Database."

³⁷⁷ "DSN 2 (Kirameki 2)," Gunter's Space Page, April 4, 2018, https://space.skyrocket.de/doc_sdat/dsn-2.htm.

farther away from Japanese shores.”³⁷⁸ *Kirameki-2* is located 92.97° east,³⁷⁹ over the Indian Ocean, assessed to be used for anti-piracy operations near Somalia, and UN peacekeeping near South Sudan.³⁸⁰ *Kirameki-1* is on-orbit east of Japan at 158° east,³⁸¹ and *Kirameki-3* is expected to take station between the two, over Japanese territory.³⁸²

Wilson writes that “Japan’s defense satellite communications represent an area in which the nation has pursued capabilities that are compatible with U.S. systems.”³⁸³ He specifically cites that the Japanese X-Band satellites could be interoperable with current U.S. X-Band systems such as WGS and DSCS.³⁸⁴ Agreeing with Wilson’s assessment, Frank Jannuzi contends, “wherever possible, “[Japan’s] indigenous systems will be designed to be interoperable with U.S. hardware and software, providing welcome redundancy in core mission areas and thereby contributing to the resilience of the alliance’s space assets.”³⁸⁵ Japanese cooperation with allies concerning space systems is not new. In the 1980s, satellite imagery was purchased from French SPOT satellites and U.S. LANDSAT satellites for use by the Japanese Defense Agency,³⁸⁶ and Japan has been cooperating with the U.S. on use of the QZSS system to complement the U.S. GPS system.³⁸⁷

QZSS is Japan’s four satellite PNT system that provides regional coverage. It has been operating since 2018 at roughly 135° east, which Fatton describes as “key to coordinate troop movements” and enable precision strike operations by the Japanese

³⁷⁸ Fatton, *Japan’s Space Program*, 19–20.

³⁷⁹ Union of Concerned Scientists, “Satellite Database.”

³⁸⁰ “Japan Military Satellite Communications,” Global Security, accessed July 11, 2021, <https://www.globalsecurity.org/space/world/japan/milsatcom.htm>.

³⁸¹ Union of Concerned Scientists, “Satellite Database.”

³⁸² Global Security, “Japan Military Satellite Communications.”

³⁸³ Wilson, *Japan’s Gradual Shift Toward Space Security*, 12.

³⁸⁴ Wilson, 12.

³⁸⁵ Wilson, 12.

³⁸⁶ Wilson, 6.

³⁸⁷ Todd Harrison and Zack Cooper, “Next Steps for Japan-U.S. Cooperation in Space,” Aerospace Security, October 28, 2016, <https://aerospace.csis.org/next-steps-japan-u-s-cooperation-space/>.

SDF.³⁸⁸ An additional three satellites are expected to be launched by 2023, allowing the system to operate independently of U.S. GPS.³⁸⁹ Additionally, Japan has two further non-military satellites which assist the SDF and present an opportunity for maritime utility and integration into an allied space coalition. Geostationary Meteorological Satellites, *Himawari 8 and 9*, are tasked by the Japanese Basic Plan to “[conduct] continuous observation,” which is essential for “monitoring typhoons, severe rain fall, and other meteorological phenomena.”³⁹⁰ The two satellites fly in close formation, as *Himawari-9* is expected to take over operations for the older *Himawari-8*.³⁹¹ The satellites, launched in 2014 and 2016, are in GEO, roughly 140.7° east, providing coverage to East Asia and the Western Pacific.³⁹²

2. Australia

Australia presents as a rather interesting case concerning space, especially in the military context. A long-time ally of the United States, and the United Kingdom, Australia was somewhat slow in recognizing the strategic necessity of a space program, which, as Moltz describes, “led to early knowledge and expertise but also some degree of complacency.”³⁹³ Moltz further states, “Australia has a long history of participation in space activities,” such as its beginnings in military space in 1946 with the Anglo-Australian Long Range Weapons Establishment, or cooperation with the U.S. military throughout the 1960s on “Corona, Midas, Rhyolite, and Defense Support Program Satellites.”³⁹⁴ Yet, as late as 2003, a government report stated “There is no strategic, economic or social reason

³⁸⁸ Fatton, *Japan’s Space Program*, 20.

³⁸⁹ Wilson, *Japan’s Gradual Shift Toward Space Security*, 11.

³⁹⁰ National Space Policy Secretariat, *Implementation Plan of the Basic Plan on Space Policy (Revised FY2017)* (Tokyo, Japan: Cabinet Office, 2017), 22.

³⁹¹ ESA Earth Observation Portal, “Himawari-8 and 9,” ESA Earth Observation Portal, n.d., <https://directory.eoportal.org/web/eoportal/satellite-missions/h/himawari-8-9#launch>.

³⁹² ESA Earth Observation Portal.

³⁹³ Moltz, *Asia’s Space Race*, 160–61.

³⁹⁴ Moltz, 161.

for the Australian Government to pursue self-sufficiency in space,” further stating that through allied cooperation it “secures access to the benefits of space.”³⁹⁵

Ultimately, thinking in Canberra would change. In July 2018, Australia established the Australian Space Agency,³⁹⁶ which stated its intent to cooperate “with the Department of Defence, where civil space activities interact with defence space activities.”³⁹⁷ A few years later, in the Australian *Department of Defence Annual Report 2019–20*, space was recognized as its own domain, under the cognizance of the Royal Australian Air Force (RAAF), noting that “[t]his role will be critical as Defence transitions from being a space ‘user’ to being a space ‘contributor’.”³⁹⁸ The following year, May 2021, the Department of Defence announced the establishment of “a Space Division headquarters within the Royal Australian Air Force in early 2022.”³⁹⁹ Regarding the space division, Air Marshall Hupfeld stated “I think we’re probably about three or four years behind where I would rather be at the moment, but we’re catching up quickly.”⁴⁰⁰ Hupfeld’s urgency, and the new Space Division, is all part of a plan that the Minister of Defence stated, is designed to develop Defence’s first wholly Australian communications constellation, and reconnaissance satellite capability by 2035, a plan that the government has pledged \$7 billion (AUS) to achieve.⁴⁰¹ Albeit slower than others in recognizing space as a strategic

³⁹⁵ Jeff Kingwell, “Punching below Its Weight: Still the Future of Space in Australia?,” *Space Policy* 21, no. 2 (April 26, 2005): 161–63, <https://doi.org/10.1016/j.spacepol.2005.03.005>.

³⁹⁶ “Australian Space Agency Charter,” Department of Industry, Science, Energy and Resources (Department of Industry, Science, Energy and Resources, October 2018), <https://www.industry.gov.au/data-and-publications/australian-space-agency-charter>.

³⁹⁷ Australian Space Agency, *Inquiry into Developing Australia’s Space Industry: Submission 55* (Canberra, AUS: Australian Space Agency, 2021), 36, https://www.aph.gov.au/Parliamentary_Business/Committees/House/Industry_Innovation_Science_and_Resources/SpaceIndustry/Submissions.

³⁹⁸ *Defence Annual Report 2019–20*, DPS: AUG016-20 (Canberra, AUS: Department of Defence, 2020), 96, https://www.defence.gov.au/annualreports/19-20/DAR_2019-20_Complete.pdf.

³⁹⁹ “Defence Announces Space Division,” Department of Defence (Defence News, May 19, 2021), <https://news.defence.gov.au/media/media-releases/defence-announces-space-division>.

⁴⁰⁰ Andrew Greene, “RAAF Looking to Establish a Space Command as It Celebrates 100 Years,” ABC News, March 30, 2021, <https://www.abc.net.au/news/2021-03-31/raaf-looks-to-space-as-it-celebrates-100-years/100039914>.

⁴⁰¹ Senator the Hon Linda Reynolds, “Defence in Space: Securing the New Frontier,” Department of Defence, July 28, 2020, <https://www.minister.defence.gov.au/minister/lreynolds/statements/defence-space-securing-new-frontier>.

domain, Defence Minister Reynolds argues “Space is truly the new frontier of both global competition and cooperation.”⁴⁰² Based on an interview with Cassandra Steer, the position of Defence Minister Reynolds is supported by Belinda Smith when she concludes, “A space division in the military will allow Australia to join its allies ‘and temper the greater powers away from what’s happening, and back towards strategic restraint’.”⁴⁰³

In terms of domestic capability, the Australian Defence Force (ADF) has no satellites of its own. *Space News* reports “Australia leans heavily on on [sic] the U.S. Wideband Global Satcom (WGS) military satellite network for the bulk of its defense communications”; however, according to Henry, it does complement the U.S. network with commercial and hosted payloads such as “Optus C1 satellite, an ultra-high frequency (UHF) hosted payload on Intelsat 22, and capacity from Inmarsat, ViaSat and SpeedCast.”⁴⁰⁴ Hosted payloads, in the case of *Intelsat 22*, are expected to save Australia over \$150 million (AUS) based on design life.⁴⁰⁵ However, throughput is limited to only 4kbps, despite having purchased the entire UHF payload, roughly 20% of *Intelsat 22*’s payload.⁴⁰⁶ This led to the Australian DOD funding the U.S. *WGS-6* satellite, and signing a memorandum of understanding (MOU) sharing agreement in 2007, for services through September 2029.⁴⁰⁷ The agreement, states the ADF’s Chief Information Office Group director, “gave Australia about 2.4 gigahertz of “assured access” to WGS X- and Ka-band capacity.”⁴⁰⁸

⁴⁰² Reynolds.

⁴⁰³ Belinda Smith, “What Is Australia’s Space Division, and Why Is It in the Military?,” ABC News, May 12, 2021, <https://www.abc.net.au/news/science/2021-05-13/australia-space-division-military-satellites-air-force-commander/100127978>.

⁴⁰⁴ Caleb Henry, “Australia’s Military Including Commercial Capacity in Its Satellite Communications Plans,” SpaceNews, May 22, 2017, <https://spacenews.com/australias-military-including-commercial-capacity-in-its-satellite-communications-plans/>.

⁴⁰⁵ “Hosted Payloads,” Intelsat, accessed July 15, 2021, <https://www.intelsat.com/solutions/professional-satellite-services/hosted-payloads/>.

⁴⁰⁶ Mark Andraschko et al., “Commercially Hosted Government Payloads: Lessons from Recent Programs,” in *2011 Aerospace Conference* (2011 IEEE Aerospace Conference, Big Sky, USA: IEEE, 2011), 1–15, <https://doi.org/10.1109/AERO.2011.5747491>.

⁴⁰⁷ Henry, “Australia’s Military Including Commercial Capacity in Its Satellite Communications Plans.”

⁴⁰⁸ Henry.

Looking towards future security needs, the RAAF is experimenting with CubeSats, where Air Vice-Marshall Cath Roberts argues: “This innovative home-grown approach has been designed to meet Australia’s unique requirements for sovereign space capability.”⁴⁰⁹ Wasting no time, the *M2 Pathfinder Mission*, and *M2 Mission*, were launched in June 2020, and March 2021, respectively.⁴¹⁰ The satellites, a combined effort of the RAAF and University of New South Wales, are meant to test homegrown technology, such as the mid-mission re-programmable software defined radio⁴¹¹ for MDA, earth observation, and communications, and in the instance of the Pathfinder M2, which Gunter’s Space Page reports, “was designed, assembled and tested in just 10 months.”⁴¹² In addition to CubeSat research, Australia is developing a domestic PNT system that would be of interest to maritime forces. Geoscience Australia received \$160.9 million (AUS) from the 2018–19 budget to design SouthPAN, a Satellite-Based Augmentation System (SBAS).⁴¹³ Augmenting current GNSS signals, a government report states that SouthPAN will provide PNT data “with decimetre accuracy.”⁴¹⁴ The system is expected to be operational by 2025, providing coverage to Australia and New Zealand, the first SBAS in the southern hemisphere.⁴¹⁵

3. South Korea

Following World War II and the Korean War, South Korea was suffering economically, a result of its industrial base falling north of the 38th parallel, rendering the

⁴⁰⁹ “UNSW and RAAF Launch CubeSat Satellites,” Australian Defence Magazine, March 24, 2021, <https://www.australiandefence.com.au/defence/cyber-space/unsw-and-raaf-launch-cubesat-satellites>.

⁴¹⁰ Australian Defence Magazine.

⁴¹¹ “RAAF M2,” Gunter’s Space Page, April 9, 2021, https://space.skyrocket.de/doc_sdat/raaf-m2.htm.

⁴¹² “RAAF M2 Pathfinder (M2PF),” Gunter’s Space Page, February 14, 2021, https://space.skyrocket.de/doc_sdat/raaf-m2-pathfinder.htm.

⁴¹³ Australian Space Agency, *Inquiry into Developing Australia’s Space Industry: Submission 55*, 28.

⁴¹⁴ Australian Space Agency, 28.

⁴¹⁵ “SouthPAN to Position Australia and New Zealand into the Future,” Geoscience Australia, December 11, 2020, <https://www.ga.gov.au/news-events/news/latest-news/southpan-to-position-australia-and-new-zealand-into-the-future>.

development of space technology—a luxury.⁴¹⁶ South Korea would not invest significantly in space until 1989, with the establishment of the Korea Aerospace Research Institute (KARI).⁴¹⁷ According to Stephanie Wan, its mandate was to develop “sounding rockets and satellites, with goals to achieve indigenous satellite technology and launch capabilities.”⁴¹⁸ The catalyst for the military space program would come in 1998, following the North’s launch of its Taepodong-1. Moltz argues the event served to highlight “the country’s fundamental reliance upon the United States for space-derived intelligence on its neighbor.”⁴¹⁹ A few years after the launch, military space endeavors began in earnest with establishment of the Agency for Defense Development.⁴²⁰ Since 2005, writes Moltz, the agency operated a facility dedicated to “control the country’s military space communications.”⁴²¹ In 2007, midgrade officers began training at the U.S. Air Force’s National Security Space Institute, and the Republic of Korea (ROK) Air Force formally established their Space Development Branch.⁴²²

Research and development aside, Seoul took its first operational steps in space security in 2015, opening the ROK Air Force Space Operations Center, reported by the Korea Times as “the first-ever state-run space situation room of the nation.”⁴²³ The operations center receives space intelligence data from the U.S., a result of a MOU between the ROK Air Force and U.S. Strategic Command.⁴²⁴ The first of three steps, the ROK ultimately hoped to establish a platoon managing a constellation of surveillance satellites

⁴¹⁶ Moltz, *Asia’s Space Race*, 139.

⁴¹⁷ Stephanie Wan, *U.S. – South Korean Space Cooperation: A Background on South Korea’s Space Program, America’s Geopolitical Influences, and Future Areas for Strategic Collaboration*. (Broomfield, Colorado: Secure World Foundation, 2010), 4.

⁴¹⁸ Wan, 4.

⁴¹⁹ Moltz, *Asia’s Space Race*, 144.

⁴²⁰ Moltz, 151.

⁴²¹ Moltz, 151.

⁴²² Moltz, 151.

⁴²³ “Air Force Opens Space Intelligence Center,” koreatimes, July 8, 2015, https://www.koreatimes.co.kr/www/nation/2021/07/113_182427.html.

⁴²⁴ “Air Force Opens Space Intelligence Center.”

by 2020, and an independent space command to execute space operations by 2040.⁴²⁵ The surveillance constellations are still yet to come to fruition, while in July 2020, Kim Hyun-chong, deputy national security advisor of South Korea stated in a press conference, “the South Korean military needs ‘unblinking eyes’ to monitor the Korean peninsula,” reiterating its reliance upon imagery from the U.S.⁴²⁶

To date, the ROK military has two communication satellites at its disposal,⁴²⁷ and the reconnaissance satellite project 425, in development.⁴²⁸ *Koreasat 5*, the ROK’s first military satellite, launched in 2006, is a dual-use satellite providing military utility and broadband multimedia and television services for the region.⁴²⁹ The satellite, however, suffered damage to its solar array drive-mechanism in 2013 and is thought to be disabled or to have significantly reduced capacity.⁴³⁰ The subsequent satellite, *ANASIS-II*, was launched in July 2020, courtesy of a SpaceX Falcon 9 rocket.⁴³¹ The French built, Airbus Space and Defence satellite is operated by the Agency for Defense and Development, providing secure military communications to the Korean Peninsula.⁴³² With little else publicly released, a consensus appears to agree that the satellite will be maintained in GEO at 115.90° east,⁴³³ over China’s eastern seaboard, and is expected to provide coverage to

⁴²⁵ “Air Force Opens Space Intelligence Center.”

⁴²⁶ Kelsey Davenport, “South Korea to Pursue Military Satellites,” Arms Control Association, September 2020, <https://www.armscontrol.org/act/2020-09/news/south-korea-pursue-military-satellites>.

⁴²⁷ Union of Concerned Scientists, “Satellite Database.”

⁴²⁸ Jung Hun Jang, “Charting a Path toward a Sustainable ROK Space Program” (Master’s Thesis, Naval Postgraduate School, 2016), 47, https://calhoun.nps.edu/bitstream/handle/10945/51725/16Dec_Jang_Jung%20Hun.pdf?sequence=1&isAllowed=y.

⁴²⁹ “Koreasat 5 (Mugunghwa 5, ANASIS 1),” Gunter’s Space Page, December 22, 2020, https://space.skyrocket.de/doc_sdat/koreasat-5.htm.

⁴³⁰ William Graham, “SpaceX Falcon 9 Successfully Launches Koreasat 5A,” *NASASpaceFlight* (blog), October 30, 2017, <https://www.nasaspaceflight.com/2017/10/falcon-9-koreasat-5a-nasa-approves-flown-boosters/>.

⁴³¹ Thomas Burghardt, “SpaceX Launches ANASIS-II Military Communications Satellite for South Korea,” *NASASpaceFlight* (blog), July 20, 2020, <https://www.nasaspaceflight.com/2020/07/spacex-launch-anasis-satellite-korea/>.

⁴³² “ANASIS 2 (KMilSatCom 1, URC-700K, Koreasat 116),” Gunter’s Space Page, July 31, 2020, https://space.skyrocket.de/doc_sdat/anasis-2.htm.

⁴³³ Jr Ng, “South Korea’s First Dedicated MilSat Nears Launch,” *Asian Military Review* (blog), June 15, 2020, <https://asianmilitaryreview.com/2020/06/south-korea-first-dedicated-milsat-nears-launch/>.

an area of 113 million square km. The ROK's next generation of satellites, Project 425, led by the French Thales Alenia Space, is expected to begin launching in 2023.⁴³⁴ \$930 million has been pledged to the project, whose objective is to produce five reconnaissance satellites: one SAR and four high-resolution electro-optical satellites.⁴³⁵ The ROK has yet to meet its objective of obtaining a devoted reconnaissance satellite constellation for its armed forces, however, evidence appears to suggest it leverages the Korea Multi-Purpose Satellite (Kompsat) constellation, also called Arirang, in the interim.⁴³⁶

KARI advertises that its satellite imagery from the Kompsat constellation is used for a wide range of applications, ranging from marine resource management to national security.⁴³⁷ *Kompsat-2*, *3*, and *3A*, are assessed to provide South Korea EO capability to monitor the Korean Peninsula 24 hours a day, regardless of weather.⁴³⁸ *Kompsat-2* was launched in July 2006 with a multi-spectral camera capable of producing 1 m panchromatic imagery and 4 m multi-spectral images, a spatial resolution that is more than 40 times better than *Kompsat-1*.⁴³⁹ Wade L. Huntley argues that while officially acknowledged as a civil satellite, the advanced spatial resolution and dual-use functionality suggests military use in the ISR mission, even drawing criticism from North Korea as a spy satellite.⁴⁴⁰ The newer satellites *Kompsat-3A*, and *Kompsat 3*, were launched in 2012 and 2015 respectively.⁴⁴¹ Jeff Jeong reports, specifically, the "South Korean military currently operates the Arirang-

⁴³⁴ Jeff Jeong, "South Korea Changes Spy Satellite Developer for \$930M Project," Defense News, April 30, 2018, <https://www.defensenews.com/space/2018/04/30/south-korea-changes-spy-satellite-developer-for-930m-project/>.

⁴³⁵ Jeong.

⁴³⁶ Jeong.

⁴³⁷ "Utilization of Satellite Images," Korea Aerospace Research Institute, accessed August 5, 2021, https://www.kari.re.kr/eng/sub03_05.do.

⁴³⁸ Tae-jun Kang, "South Korea's Quest to Be a Major Space Power," March 27, 2015, <https://thediplomat.com/2015/03/south-koreas-quest-to-be-a-major-space-power/>.

⁴³⁹ Kwang-Jae Lee, Tae-Byeong Chae, and Hyung-Sup Jung, "Earth Observation from KOMPSAT Optical, Thermal, and Radar Satellite Images," *Remote Sensing* 13, no. 1 (2021): 1, <http://dx.doi.org.libproxy.nps.edu/10.3390/rs13010139>.

⁴⁴⁰ Wade L. Huntley, "Moderate Space Powers," in *The Politics of Space: A Survey*, ed. Eligar Sadeh, 1st ed. (London, UK: Taylor & Francis Group, 2010), 80, <http://ebookcentral.proquest.com/lib/ebook-nps/detail.action?docID=614672>.

⁴⁴¹ Union of Concerned Scientists, "Satellite Database."

3 multipurpose satellite to acquire geographical information on the Korean Peninsula, including North Korea's missile and nuclear test sites."⁴⁴² All three EO satellites are operated in LEO, at altitudes of 528 km (*Kompsat-3*), and 685 km (*Kompsat-2/3A*).⁴⁴³ Taking advantage of greater technological development, *Kompsat-3* produces 0.7 m panchromatic imagery, and 2.8 km multi-spectral imagery.⁴⁴⁴ *Kompsat-3A*, with a lower orbit, improves upon this further with spatial resolutions of 0.55 m and 2.2 m (panchromatic / multi-spectral), with an additional infrared sensor adding an all-weather capability with a 5.5 m resolution.⁴⁴⁵

In 2013, Korea's first domestic SAR satellite, *Kompsat-5*, was launched to its operating orbit of 550 km.⁴⁴⁶ This all-weather SAR satellite produces high (1 m), standard (3 m), and wide area (20 m) resolution imagery.⁴⁴⁷ *Kompsat-5* and the three EO satellites operate in an inclined sun-synchronous orbit,⁴⁴⁸ producing consistent imagery (SAR/EO/IR) for use in precision map production, change detection, Geographical Information Systems (GIS), and intelligence applications.⁴⁴⁹ Whether or not the satellites are devoted MILSATs in nature, the quality of imagery produced by South Korea's Kompsat constellation has military and intelligence utility and should be considered for integration into a coalition structure. This is not unlike what the U.S.'s own National Reconnaissance Office does, acquiring high-quality imagery from commercial sources, through its

⁴⁴² Jeong, "South Korea Changes Spy Satellite Developer for \$930M Project."

⁴⁴³ Lee, Chae, and Jung, "Earth Observation from KOMPSAT Optical, Thermal, and Radar Satellite Images," 2.

⁴⁴⁴ Lee, Chae, and Jung, 2.

⁴⁴⁵ Satellite Imaging Corporation, "KOMPSAT-3A Satellite Sensor," accessed August 5, 2021, <https://www.satimagingcorp.com/satellite-sensors/kompsat-3a/>.

⁴⁴⁶ "Korea Multi-Purpose Satellite (KOMPSAT, Arirang)," Korea Aerospace Research Institute, accessed August 5, 2021, https://www.kari.re.kr/eng/sub03_02_01.do.

⁴⁴⁷ Korea Aerospace Research Institute.

⁴⁴⁸ Union of Concerned Scientists, "Satellite Database."

⁴⁴⁹ Satellite Imaging Corporation, "KOMPSAT-3A Satellite Sensor"; Lee, Chae, and Jung, "Earth Observation from KOMPSAT Optical, Thermal, and Radar Satellite Images," 2.

Commercial Systems Program Office, a venture endeavoring to maximize emerging commercial capabilities, and integrate the data with that of national constellations.⁴⁵⁰

Two additional non-military systems of interest to maritime forces are the ROK's two meteorological satellites, GEO *Kompsat-2A* and GEO *Kompsat-2B*, used for weather observation and ocean/environmental observations, respectively,⁴⁵¹ and the ROK's domestic SBAS, Korean Augmentation Satellite System (KASS), expected to be operational in 2022, with signal coverage over the East Asian region.⁴⁵²

C. IMPACT ON NAVAL MISSIONS

This section now turns towards the application and advantages to be gained from the integration of allied space systems throughout the Indo-Pacific. The same structure from Chapter III is followed, maintaining a focus on maritime operations, specifically in terms of the missions of communications, MDA, and METOC. Maritime forces in the Western Pacific face a variety of challenges stemming from China's rise in regional influence and proclivity to continue its "salami slicing" strategy and grey zone tactics.

1. Communications

As discussed in the previous chapter, greater interoperability, resiliency, and improved bandwidth are all possible benefits derived from allied space cooperation. These same trends are seen with Asian allies, simply to a lesser magnitude. As China seeks to gain advantages through deception and denial of its adversaries' equipment, in what the DIA reports, Beijing plans to be "informatized local wars,"⁴⁵³ the importance of these benefits, especially resiliency, expands.

In terms of "fight tonight" capability, only Japan and South Korea have the potential to augment the communications mission. Japan's two, Kirameki series satellites,

⁴⁵⁰ Pete Muend, "Commercial Systems Program Update" (presentation, (virtual) Silver Spring, MD, April 27, 2021), 2–3, https://www.nesdis.noaa.gov/CRSRA/pdf/29th_ACCRES_CSPO_Peter_Muend.pdf.

⁴⁵¹ Jang, "Charting a Path toward a Sustainable ROK Space Program," 44.

⁴⁵² "Korea to Launch SBAS IN 2022," *Inside GNSS - Global Navigation Satellite Systems Engineering, Policy, and Design* (blog), November 18, 2020, <https://insidegnss.com/post/>.

⁴⁵³ Defense Intelligence Agency, *Challenges to Security in Space*, 14.

located at 92.97° east and 158° east, are positioned such as to provide MILSAT coverage from the Indian Ocean eastward, to beyond the Hawaiian Islands. The satellites can augment and provide resiliency to U.S. X-Band communications (WGS and DSCS), if not integrated into a fully interoperable coalition constellation, ensuring beyond line-of-sight communications to maritime forces conducting FONOPS and other maritime security initiatives.

On paper, South Korea has two communications satellites that can contribute to maritime operations: *Koreasat-5* and *ANASIS-II*. Operationally, however, it is unlikely that both satellites would integrate into an allied network, considering the damage to *Koreasat-5* in 2013. Whatever capacity remains is likely to be wholly allocated domestically for South Korean independent operations and strategic autonomy. The newer French-built satellite, however, would be a likely candidate to join with allied assets, providing secure military communications over both the East and South China Seas.

Australia does not currently maintain any military communications satellites; however, it should be noted that they have already begun partial integration into the U.S. SATCOM architecture, fully funding *WGS-6*, which provides coverage throughout the central Pacific,⁴⁵⁴ and ensures continuity of communications for 3rd Fleet Forces enroute to the 7th Fleet AOR. However, looking towards the future and the continued need for resiliency of space assets through the “proliferated LEO” concept, Australia’s CubeSat research stemming from the *M2 Pathfinder* and *M2 mission* has the potential to contribute.

2. Maritime Domain Awareness

The DOD argues that “[g]iven the size of the Asian maritime domain, no coastal State can provide effective maritime domain awareness on its own.”⁴⁵⁵ Therefore, allied and partner nations are essential to this mission. Only Japan maintains a fleet of dedicated military reconnaissance satellites, however, South Korea’s Kompsat constellation could be leveraged to some degree. Additionally, like Japan’s QZSS system, both Australia and

⁴⁵⁴ “WGS F6 (USA 244),” N2YO, accessed July 22, 2021, <https://www.n2yo.com/?s=39222>.

⁴⁵⁵ Department of Defense, *The Asia-Pacific Maritime Security Strategy: Achieving U.S. National Security Objectives in a Changing Environment*, 28.

South Korea have domestic SBAS systems in development: SouthPAN and KASS. These systems, while not able to provide uncooperative tracking, will augment the U.S. GPS constellation, providing for a clearer common operational picture in terms of blue force tracking and commercial vessels, essential tasks while operating in some of the busiest waterways in the world. This will generate better situational awareness for commanders conducting presence operations, such as the Taiwan Strait Transit conducted by *USS Curtis Wilbur* (DDG-54) in June 2021, the sixth transit under the Biden Administration.⁴⁵⁶

Moreover, leveraging the combined reconnaissance capabilities of an allied coalition could help build alliance solidarity and deny China unhindered exploitation of disputed features in the SCS. Whereas previously, long-range reconnaissance aircraft were required, reconnaissance satellites, writes Glenn Schloss, “will enhance transparency and contribute to confidence-building among rival nations.”⁴⁵⁷ Encouraging the sharing of reconnaissance data in this manner, through the use Japan’s IGS constellation, and high-resolution imagery from the ROK’s Kompsat satellites, could help to build trust amongst allied nations. Moreover, the ability to persistently monitor China’s activity on disputed features will allow for early detection of militarization and potential crisis, which Schloss argues will allow decision makers the ability “to seek to defuse tensions through diplomacy,” rather than military action.⁴⁵⁸ These constellations could also be used to monitor for the presence of Chinese auxiliary vessels carrying deep submersibles that have the potential to threaten the integrity of undersea cables in the SCS. Overall cooperation in this nature could help build stability and reduce tensions, benefitting not only the U.S. Navy, but that of its allies, partners, and even adversaries operating in and around the SCS.

Finally, greater coverage and situational awareness generated from allied reconnaissance satellites will assist maritime forces facing the challenge of China’s A2/AD network. Chinese doctrine is very favorable on the use of deception, cyber, and EW

⁴⁵⁶ Sam LaGrone, “Destroyer Makes Sixth Taiwan Strait Transit During Biden Administration,” *USNI News* (blog), June 22, 2021, <https://news.usni.org/2021/06/22/destroyer-makes-sixth-taiwan-strait-transit-during-biden-administration>.

⁴⁵⁷ Glenn Schloss, “Satellites of War... and Peace,” *South China Morning Post*, September 3, 2001.

⁴⁵⁸ Schloss.

attack. Employing this strategy in support of its A2/AD network, the adversary, argues Alex Vershinin, will “[engage] from unexpected locations by modern air defenses, including long-range surface-to-surface missiles and fixed-wing fighter aircraft.”⁴⁵⁹ A more robust, and defensible reconnaissance architecture spread amongst regional allies, will help allied maritime forces to operate effectively under the threat of an A2/AD umbrella. Even when challenged in space, the navy will retain its benefit of situational awareness, and early warning in movements of missile launchers, aircraft, and even construction of new A2/AD assets on disputed features. High resolution sub-meter class imagery from South Korea could be critical in detecting changes to both artificial features and military infrastructure in the SCS. Assured access and understanding of what is moving in and entering the maritime domain will allow the U.S. Navy and its allies to overcome the challenges faced in great power competition.

3. Meteorological and Oceanographic Operations

The importance of assured METOC data and forecasting for maritime forces operating in the Indo-Pacific cannot be understated. Threats to forces are generated not simply from hostile interactions, but from nature and weather as well. The prime example generates from Admiral Halsey’s loss of hundreds of sailors and three destroyers to a typhoon (see Chapter II) in the last major maritime campaign of the World War II theater. Moreover, Bob Gough contends that it is “an area prone to natural disasters, particularly cyclones and earthquakes,” whereby “military services are often required to distribute aid and deliver medical care, as well as to establish communication systems,” a result of compromised infrastructure that can delay relief efforts.⁴⁶⁰ HA/DR remains a vital mission for the United States, in terms of preventing suffering and loss of life for hundreds of thousands of people, but also as a means of further demonstrating U.S. commitment, resolve, and leadership throughout the Indo-Pacific.

⁴⁵⁹ Alex Vershinin, “The Challenge of Dis-Integrating A2/AD Zone: How Emerging Technologies Are Shifting the Balance Back to the Defense,” *Joint Forces Quarterly*, no. 97 (March 2020): 18.

⁴⁶⁰ Bob Gough, “The Pivot To APAC Is Underway... And So Is The Demand For Capacity,” *Milsat Magazine*, March 2014, <http://www.milsatmagazine.com/story.php?number=731260652>.

The military's legacy Defense Meteorological Satellite Program (DMSP) is the oldest still operational satellite program, yet replacement weather satellites, write Harrison and Daniels, "have run into repeated acquisition problems over the past decade."⁴⁶¹ The U.S.'s newest weather satellites, the Geostationary Operational Environmental Satellite (GOES) program, while operational, fail to cover the region of the Western Pacific (100°-130° east), focusing on the continental U.S., to include Alaska and Hawaii.⁴⁶² In this disaster prone area of operations, this is a mission that allied space cooperation can significantly leverage, providing newer, reliable, and redundant meteorological satellites to assist forecasting in support of maritime security forces and the HA/DR mission. Both Japan and South Korea maintain meteorological satellite systems relevant to this mission.

The Himawari satellites, operated by the Japan Meteorological Agency, currently share data with NOAA;⁴⁶³ however, formal incorporation into an allied space coalition would help ensure persistent and assured weather forecasting for maritime forces operating in the South and East China Seas. The same is true of South Korea, which operates its meteorological satellites, GEO *Kompsat-2A* and GEO *Kompsat-2B*. These four satellites all provide coverage to the western Pacific, ranging from *Kompsat-2B* at 128.00°, to *Himawari-9* positioned more eastward at 140.7°. Allied meteorological satellites are better positioned than their U.S. counterparts, providing variability that, Camacho-Lara et al. write, is "a very useful redundancy of coverage that is particularly important in tracking major storms and obtaining the most up-to-date information of atmospheric, oceanic, and of arctic conditions."⁴⁶⁴

⁴⁶¹ Harrison and Daniels, *Analysis of the FY 2021 Defense Budget*, 39.

⁴⁶² Union of Concerned Scientists, "Satellite Database."

⁴⁶³ National Oceanic and Atmospheric Administration, "Full Disk: Himawari-8," NOAA Geostationary Satellite Server, accessed July 11, 2021, https://www.goes.noaa.gov/f_himawari-8.html.

⁴⁶⁴ Sergio Camacho-Lara, Scott Madry, and Joseph N. Pelton, "International Meteorological Satellite Systems," in *Handbook of Satellite Applications*, ed. Joseph N. Pelton, Scott Madry, and Sergio Camacho-Lara (New York, NY: Springer, 2013), 1021, https://doi.org/10.1007/978-1-4419-7671-0_56.

D. ALLIANCE STRUCTURE COMPARISON

This final section compares the three proposed alliance structures in the context of Japan, Australia, and South Korea. As the space programs and architectures of Asia are themselves less robust than in Europe, the section will primarily account for the countries' individual space policies, doctrine, and histories to better understand how they might influence the structure of an allied space coalition throughout the region. The section closes with discussion of the actual impact of Asian space systems on the different coalition structures. In parallel to the thinking of Chapter III, specific policy recommendations and conclusions drawn from the discussion are withheld for analysis in the concluding chapter.

When addressing the subject of coalition building and increased cooperation in the Indo-Pacific, it is important to remember the regional history and its traditional alliance structure. In a 2021 statement before a House subcommittee concerning Asian affairs, Richard N. Haass addressed this exact issue concerning regional alliances: “While Washington will always be the hub of its alliance system, the spokes should be encouraged to do more with each other. An important piece of this effort will be to repair relations between Seoul and Tokyo.”⁴⁶⁵ In short, Indo-Pacific alliances have long been bilateral in nature, with relationships amongst allies rather tense, stemming from decades old tension and mistrust between South Korea and Japan, or even the result of Imperial Japanese forces bombing Darwin, Australia, during WWII.⁴⁶⁶

The status quo for security alliances in the Indo-Pacific is a Cold War concept, the hub-and-spokes alliance system (bilateral), with limited cross-spoke cooperation.⁴⁶⁷ In terms of establishing an allied space coalition involving Indo-Pacific allies, this will certainly be the simplest method of building cooperation, especially given the mistrust amongst the U.S.'s allies. This approach appears favorable given evidence outlined in

⁴⁶⁵ Richard N. Haass, *U.S. Policy toward the Indo-Pacific: The Case for a Comprehensive Approach* (Washington, DC: Council on Foreign Relations, 2021), 2, <https://www.cfr.org/report/us-policy-toward-indo-pacific-case-comprehensive-approach>.

⁴⁶⁶ The Congressional Research Service, *Indo-Pacific Strategies of U.S. Allies and Partners: Issues for Congress*, R46217 (Washington, DC: The Congressional Research Service, 2020), 8, <https://www.everycrsreport.com/reports/R46217.html>.

⁴⁶⁷ Simón, Lanoszka, and Meijer, “Nodal Defence,” 364.

section B. Asian allies' space systems are more domestically derived, with little to no international cooperation, in sharp contrast to the space programs of Europe.

Drawing upon Michael Horowitz's Adoption-Capacity Theory, whereby innovations requiring a lower threshold of organizational capital and financial intensity are more readily adopted, the case for bilateral cooperation appears to fit the bill.⁴⁶⁸ By carrying over the status quo of alliances into the space domain, existing alliances will simply expand more formally into space. Little to no adoption of a new concept is required (organizational capital), and the financial burden should remain minimal, as existing structures and features of security coordination with the U.S. will be maintained without a need for significant change. However, while arguably the status quo to date, this structure has already begun trending towards more expansive cooperation. Simón et al., observe a shift in regional policies, seemingly overcoming past barriers to cooperation, which they proclaim is driven by fear of North Korea's "nuclear and missile threat" and China's rise.⁴⁶⁹ The evidence, they argue, is observed in the "trilateral defence cooperation" between the U.S., Japan, and South Korea, "the U.S.-Japan-Australia trilaterals as well as the so-called 'Quad' between Washington, Tokyo, Canberra and Delhi."⁴⁷⁰

Simón et al. also found that while U.S. allies in East Asia still frame their security initiatives around localized threats, China's rise "has gradually become a region-wide threat" that "has catalysed greater defence cooperation among previously disconnected allies and partners."⁴⁷¹ Overcoming a lack of trust and even open hostility amongst allied nations will be the largest hurdle in truly developing a regional space coalition. Additionally, trust, or lack thereof, concerning the United States and its sharing of intelligence, has previously shown to be a factor in the development of domestic space programs in both Japan and South Korea. Furthermore, South Korea greatly desires its own

⁴⁶⁸ Michael C. Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton, New Jersey: Princeton University Press, 2010), 33, <http://ebookcentral.proquest.com/lib/ebook-nps/detail.action?docID=539794>.

⁴⁶⁹ Simón, Lanoszka, and Meijer, "Nodal Defence," 377–78.

⁴⁷⁰ Simón, Lanoszka, and Meijer, 377–78.

⁴⁷¹ Simón, Lanoszka, and Meijer, 362.

military satellite architecture, yet remains reluctant, and as Jung Hun Jang writes, fearful “that launching independent military reconnaissance satellites is expensive and could harm the ROK–US alliance.”⁴⁷²

Chung Min Lee acknowledges the ROK-U.S. bilateral relationship has been strained over the previous four years, yet writes that it has improved under the Biden administration, such that “there could be closer alignment between Seoul and Washington on Indo-Pacific security issues,” whereby “there may be more willingness on South Korea’s part to engage with U.S. policy toward the region.”⁴⁷³ However, Lee does note that “South Korea is likely to be much more cautious than other U.S. allies such as Japan and Australia,”⁴⁷⁴ even highlighting early on that South Korea is uniquely positioned amongst U.S. allies, as it “is the only country that has maintained historical ties with China for more than a thousand years.”⁴⁷⁵ In short, South Korea appears open to the idea of expanded regional cooperation, albeit not necessarily to the extent of Australia or Japan. However, it is important to note that Seoul’s willingness to expand cooperation may be tempered by historical tensions with Japan. Relations between Seoul and Tokyo have even just recently deteriorated. Park Byong-su, reporting on South Korea’s 2020 defence white paper, observes that Japan was downgraded from a partner, and is now listed as a “neighboring country with whom we need to collaborate.”⁴⁷⁶ Similarly, South Korea’s role in security cooperation, was downgraded in Japan’s own 2020 defence white paper.⁴⁷⁷ Yet, Da Zhigang points out, “South Korea feels that it cannot ‘downgrade’ its ties with Japan to a level that the U.S.

⁴⁷² Jang, “Charting a Path toward a Sustainable ROK Space Program,” 13.

⁴⁷³ Chung Min Lee, *2021 Korea Strategic Review: Is South Korea Going Global? New Possibilities Together With the Biden Administration* (Washington, DC: Carnegie Endowment for International Peace, 2021), 24, <https://carnegieendowment.org/2021/07/13/is-south-korea-going-global-new-possibilities-together-with-biden-administration-pub-84922>.

⁴⁷⁴ Lee, 24.

⁴⁷⁵ Lee, 3.

⁴⁷⁶ Park Byong-su, “S. Korean Defense White Paper Lists Japan Only as ‘Neighbor,’ Not ‘Partner,’” *Hankyoreh*, February 3, 2021, https://english.hani.co.kr/arti/english_edition/e_international/981657.html.

⁴⁷⁷ Byong-su.

does not want to see,” and still acknowledges it must cooperate with Japan in regional security efforts.⁴⁷⁸

Alternatively, Australia and Japan are perceived to look favorably upon a regional space coalition, despite some mistrust stemming from Japan’s hostile actions of WWII. In its 2020 Defence Strategic Update, Australia states it “will continue to work to strengthen defence and diplomatic ties with the countries in Australia’s immediate region, working alongside important partners such as the United States, Japan and New Zealand.”⁴⁷⁹ Similarly, Japan had stated its position, in an outline of its 2020 Basic Plan on Space Policy as intending to achieve “economic prosperity and ensuring peace and stability in cooperation with the ally and partners [sic].”⁴⁸⁰ Both countries maintain the importance of cooperation with the U.S. and allies, yet a theme similar to that of Europe has emerged—strategic independence in space. Japan announced its goal “to become a self-sustained space faring nation,” while still “strategically collaborating with its ally and partners.”⁴⁸¹ Australia too, advocates the importance of its “sovereign space infrastructure.”⁴⁸² This desire to maintain strategic independence in space will need to be accounted for when building an allied space coalition. However, allies may recognize a benefit to interdependence as a means of reducing their individual financial burdens.

The rise of China has certainly served as a catalyst, encouraging greater regional security efforts, a position which is accounted for in the military and space policies of the three nations. However, mention of expanded or global space cooperation is also supported, simply appearing as a lower priority given the localized threat of China. In 2017, Japan addressed the impact of satellites on MDA in its space policy and announced it “will

⁴⁷⁸ Da Zhigang, “South Korea’s Defense White Paper Strikes a Pragmatic Tone,” *Global Times*, February 5, 2021, <https://www.globaltimes.cn/page/202102/1215075.shtml>.

⁴⁷⁹ Department of Defence, *2020 Defence Strategic Update*, 2020, 22.

⁴⁸⁰ National Space Policy Secretariat, *Outline of the Basic Plan on Space Policy (Provisional Translation)*, 4.

⁴⁸¹ National Space Policy Secretariat, 4.

⁴⁸² Australian Space Agency, *Advancing Space: Australian Civil Space Strategy 2019–2028* (Canberra, AUS: Australian Space Agency, 2019), 3, <https://publications.industry.gov.au/publications/advancing-space-australian-civil-space-strategy-2019-2028.pdf>.

continuously strengthen collaboration with the U.S., France and other countries,” even further stating a desire to contribute to an “international earth observation network.”⁴⁸³ As noted in section B, Japan has collaborated with France since the 1980s, further supporting its willingness to enter a more expansive coalition.

As a member of Five-Eyes, Australia appears to have the most favorable posture towards global cooperation. However, formal Australian space policy to support this position is non-existent, such that Malcom Davis argues, “Australia lacks a definitive declaratory defence space strategy or policy.”⁴⁸⁴ But, their actions in space activity paint a clearer picture. As of 2018, Australia was a member of the U.S.-led Combined Space Operations Center (CSpoC) and Operation Olympic Defender, alongside the UK, Canada, and New Zealand.⁴⁸⁵ Yet, despite the advantages of this cooperation, Davis would appear to urge caution. He suggests that as a middle power, Australia must be wary of the counterspace threats faced from China, and tread cautiously in the “intensifying China-US military-strategic competition.”⁴⁸⁶ South Korea, by comparison, is similar in the fact that its space policy is sparse at best, providing no formal policy on their position. The U.S. would certainly welcome Seoul into a global coalition, evidenced by Cohen’s characterization stating, “he [Colonel Scott Brodeur] expects new partnerships with countries like Japan, Italy, and ‘maybe even South Korea,’ in the near future.”⁴⁸⁷ In a June 6, 2021 speech, South Korean President Moon Jae-in, announced “We will expand space-related cooperation with the international community, including the United States, and

⁴⁸³ National Space Policy Secretariat, *Implementation Plan of the Basic Plan on Space Policy (Revised FY2017)*, 48,102.

⁴⁸⁴ Malcolm Davis, *The Australian Defence Force and Contested Space* (Barton, Australia: The Australian Strategic Policy Institute, 2019), 30.

⁴⁸⁵ Rachel S. Cohen, “Building the New Space Coalition,” *Air Force Magazine* (blog), March 26, 2021, <https://www.airforcemag.com/article/building-the-new-space-coalition/>.

⁴⁸⁶ Davis, *The Australian Defence Force and Contested Space*, 37.

⁴⁸⁷ Rachel S. Cohen, “CSPOC Building a More Global Space Force,” *Santa Maria Times*, March 13, 2020, https://santamariatimes.com/news/local/military/vandenberg/cspoc-building-a-more-global-space-force/article_d870fc9a-78ce-5618-bcc5-75103637dcff.html.

usher in a new space era for the Republic of Korea.”⁴⁸⁸ Without any formal military space policy to refute or confirm the statement, Seoul can be assessed, at a minimum, open to the possibility of space cooperation beyond simply the Indo-Pacific.

In terms of strict military utility, the variability across the proposed alliance structures for the Indo-Pacific is more nuanced than in Europe. Japan clearly stands out amongst the U.S.’s Asian allies, as far as overt military space assets are concerned. However, engaging in simple bilateral agreements rather than a broader regional alignment might be a mistake. Certainly, a bilateral structure is simplest and would provide the U.S. access to the military space assets of Japan, but it could be short sighted. Regional and global coalition structures might present a more favorable option from an operational perspective. Cooperation and coordination now could help bolster nascent military space programs allowing for greater collective deterrence and military utility in the long term.

The ROK’s Kompsat constellation could be leveraged in a regional coalition, despite a lack of trust amongst U.S. regional allies. Its unclassified imagery could be used to overcome lack of trust in the region, which hinders the sharing of more protected data from military satellite systems, and even be used to even build trust. Writing about Afghanistan and Iraq, George Seffers notes that satellite imagery used to support operations is typically “only available at the secret level and above. Very few partners have access to this classified data, and this limitation hinders collaboration...”⁴⁸⁹ Seffers reports that commercial unclassified sources were used to fill these gaps, allowing for easier open sharing.⁴⁹⁰ The ROK’s Kompsat constellation could be used in this sense, allowing for cooperation amongst allies that may not yet have the trust to cooperate spoke-to-spoke, generating a more robust coalition and not sticking to a Cold War era structure.

A global coalition structure might provide even greater collective deterrence than that of a regional one. Moreover, the growing military space programs in Asia would be

⁴⁸⁸ Korean Culture and Information Service, “Address by President Moon Jae-in on 66th Memorial Day,” Korea.net, June 6, 2021, <https://www.korea.net/Government/Briefing-Room/Presidential-Speeches/view?articleId=199246&categoryId=111&language=A020101&pageIndex=4>.

⁴⁸⁹ George I. Seffers, “Satellite Snapshots Fill Imagery Gap,” *Signal* 65, no. 7 (March 2011): 1.

⁴⁹⁰ Seffers, 1.

strengthened by access to resources, experience, and satellite assets, not just from the United States but from those of Germany, France, and the UK. From a U.S. perspective, further development of the military space programs in Asia is favorable. In the context of global great power competition, development of these military space programs will only serve to add a greater diversity of assets, geographical dispersion, and capability to a coalition. For operational maritime forces, this will mean a higher probability of maintaining assured access to—communications, MDA data, weather forecasting, and weapons system modeling—essential to operating in a Chinese A2/AD environment.

Having concluded the second of two regional case studies, addressing China’s rise to power and subsequent impact on the Indo-Pacific, the following chapter draws upon both the European and Asian perspective to present comprehensive findings and outline policy recommendations. Without being redundant, Chapter V draws conclusions based on evidence derived from the case studies and presents a case for the optimal coalition structure, given the history, capabilities, and regional geopolitics observed in France, Germany, and Great Britain in Europe; and Japan Australia, and South Korea, in the Indo-Pacific.

V. SUMMARY AND CONCLUSION

In an era of renewed great power competition, the U.S. finds itself challenged by Russia and China. In this context, the U.S. seeks to leverage allies as force multipliers and means of overcoming emerging challenges. In the maritime realm, the United States Navy is the forward presence of the U.S., facing these challenges as they emerge in the regions near these allies. This thesis has studied how allied space cooperation might enhance naval operations and examined possible alternative structures for a U.S.-led space coalition to improve maritime operations. Two case studies were conducted evaluating current U.S. allies, their space capabilities, policies, and histories. The European case study examined Germany, France, and the UK, and their possible contributions to maritime forces facing challenges from Russia in the Mediterranean and Arctic. In the Asian case study, Japan, Australia, and South Korea were evaluated relative to the operational challenges in the South China Sea and a Taiwan contingency, resulting from the rise of China.

A. CASE STUDIES

This section briefly summarizes the key findings and notable takeaways from each of the two regional case studies and informs the policy recommendations outlined in section B.

1. Europe

When examining alliance structures in Europe, an emerging trend is observed. Institutionalized multinational alliances are beginning to fragment in a shift towards multitudes of bilateral agreements. The fragmentation was a result of increased political differences, variation in threat perception, and rising European nationalism felt throughout the European nations, as well as a broader concern that NATO had experienced a loss of purpose after the fall of the Soviet Union.

From an operational perspective of the U.S. navy, aligning its efforts with the fragmentation in Europe would not appear to generate any loss in capability; however, this approach will weaken the individual European allies as they would lose cross-coalition

benefits, and the curated bilateral alliances will see a greatly reduced collective deterrence capability concerning the individual space architectures. Furthermore, the space programs and policies of the U.S.'s European allies are interconnected financially and operationally, both between the nations and institutions, as was seen in France's Helios program and the NATO SATCOM Post-2000 program, described in Chapter III.

At a minimum, efforts at building a space coalition with the U.S.'s European allies should seek a regional structure. Disentangling the interdependent space programs of Europe will be not only challenging, but downright detrimental and destabilizing to the region. European interdependence in space is a benefit for the U.S. and should be encouraged, further leveraging burden sharing and building alliance solidarity. Moreover, both French and British space policies expressed a global outlook and possible desire for expanded cooperation beyond the minimum recommended regional space coalition. In the European case study, only German space policy provides any evidence to suggest a possible desire for restraint when considering a global space coalition. Yet, German space policy is very utilitarian in nature, seeking "avoidance of duplicate activities and structures."⁴⁹¹ It can be presumed that as a utilitarian measure, Germany will support a global space alliance for the purpose of leveraging greater collective deterrence, increased burden sharing, and a significant reduction in redundant systems. Additionally, in a European nationalist environment, if France, a European leader and preeminent space power, agreed to a global space coalition, Germany might too be persuaded. Ultimately, considering the U.S.'s European allies, a U.S. led space coalition should at a minimum be regional in nature, yet strive for the benefits of the expanded global space coalition.

2. Asia

In Asia, U.S. allies are entrenched in bilateral alliance structures, the result of Cold-War era alliance building and historical tensions between the nations themselves. Japan's imperialist history of the late 19th and early 20th centuries is responsible for significant tensions between Seoul and Tokyo, and to some extent Canberra. However, fear of China's

⁴⁹¹ Federal Ministry of Economics and Technology, *Making Germany's Space Sector Fit for the Future: The Space Strategy of the German Federal Government*, 29.

rise and the nuclear threat from an unstable North Korean regime are believed to have facilitated greater cooperation amongst the three U.S. allies, seeking to overcome the greater regional threats, as described in the alliance structure comparison in Chapter IV.

Operationally, as in Europe, the difference between a bilateral approach versus regional or global cooperation will be unsubstantial, as the U.S. will gain the benefit of access to each countries' satellite architecture, regardless of the chosen alliance structure. A bilateral approach, however, is short sighted. It will fail to generate any significant collective deterrence in Asia, nor will it generate any benefit of burden sharing. As the majority stakeholder of space assets in bilateral agreements, the U.S. will ultimately bear the burden of providing satellite coverage, when needed, to each country, rather than share the burden across assets of regional neighbors. Furthermore, apart from Japan, the space programs of the countries reviewed in the second case study are newly formed, and while Japan has a developed program, its military space capabilities are barely a decade old. Maintaining bilateral cooperation in Asia will prevent the U.S.'s allies from having both the stability derived from collective deterrence and the benefits that greater cooperation and coordination will have on the developing military space programs.

Given the historical tensions within Asia, a global approach to a space coalition, may be even more readily accepted amongst the allies, rather than a regional coalition structure. The addition of Germany, France, and the UK to the alliance structure can help to pacify tensions and assist in building trust. For example, South Korea can leverage resources and space-based intelligence from its European allies in a global coalition, rather than directly relying upon its more tenuous relationship with Japan. However, while receiving direct support from Europe, South Korea can still passively cooperate with Japan in terms of collective deterrence and can over time rebuild ties between Seoul and Tokyo, slowly overcoming the lack of trust. Ultimately, for the U.S. and its allies, greater cooperation throughout the Indo-Pacific will bolster allied space programs and generate greater long-term benefits.

B. POLICY RECOMMENDATIONS

As Russia and China both operate trans regionally, so too should the United States. Facing these trans regional threats and nations with proven counterspace capabilities, the U.S. should seek a global space coalition which is most favorable for enhancing U.S. naval operations, especially considering the long-term strategic implications of great power competition. This coalition structure will leverage the combined space assets of global allies, providing the greatest benefit in terms of collective deterrence and burden sharing, allowing for faster development of nascent military space programs through access to a broader pool of resources and experience. This approach will ensure mission assurance of communications, MDA data, and METOC support to U.S. and allied naval forces. Forward deployed ships will have improved access to bandwidth and greater throughput enabling network centric warfare. Allied SAR and EO reconnaissance satellites will increase mission assurance, ensure global coverage, and shorten revisit times, providing enhanced MDA and pattern of life for Russian submarines getting underway or Chinese warships in the SCS. Regional weather satellites will ensure timely and accurate weather forecasting and sensor performance modeling, reducing the risk of weather damage, ensuring sensor performance, and assisting in HA/DR response planning.

According to Kelly McCoy, the strategic environment today has become “transregional, multi-domain, and multi-functional,” leading him to the conclusion that geographic COCOMs fail to retain their relevance for present and future security needs.⁴⁹² Space coalitions can be viewed in parallel to this argument. The challenges faced in space and even satellites themselves are inherently global and multi-domain in nature. If there is a question of whether geographically delineated COCOMs remain relevant, it should be no stretch to make the case in space, an even more geographically diverse domain, that limiting alliances to a Cold War era force structure will be folly.

To best leverage a global space coalition, three additional policies are recommended for integration into the coalition framework. First, allies in both Europe and

⁴⁹² Kelly McCoy, “The World the Combatant Command Was Designed for Is Gone,” *War on the Rocks* (blog), October 7, 2016, <https://warontherocks.com/2016/10/the-world-the-combatant-command-was-designed-for-is-gone/>.

Asia should be encouraged to design their future military space architectures in a manner consistent with the *United States Space Force Vision for Satellite Communications (SATCOM)*⁴⁹³ and the U.S. Navy's Project Overmatch. This means developing systems able to operate and integrate into an enterprise architecture, rather than legacy stovepipe architectures. Specifically in the maritime domain, Project Overmatch is the Navy's initiative to develop a joint naval operational architecture, capable of enabling a common communication capability across domains and services in support of the Joint All-Domain Command and Control (JADC2) construct.⁴⁹⁴ Furthermore, a challenge to the global coalition structure will be a useable sharing mechanism for data amongst the allies. A coalition cloud-based infrastructure, like the Navy's Project Overmatch, could bridge this gap. Hosting servers amongst allied participants will provide resilience through global geographical dispersion and collective buy in from allies.

Second, the USN and DOD at large should not only seek to cooperate with allies in satellite capability, but should leverage the unique geographies and launch capabilities of its allies. In a conflict emerging from great power competition, the U.S. will now face peer adversaries capable of threatening domestic launch sites. Launch sites such as the ESA's spaceport in Kourou, French Guinea, or future launch sites in Australia provide advantageous equatorial launch sites and would generate resiliency for a global space coalition, providing the means for assured access to space launch capabilities. Furthermore, the U.S. should leverage the alternate orbital launch vehicles of its allies, such as the French Ariane rockets, Korean Space Launch Vehicle (KSLV), or Japan's H-II rockets. This will allow for diversity in not only launch geography but resiliency of launch platform.

A third and final recommendation is to promote not only integration within the coalition but interdependence to capitalize on burden sharing. The German utilitarian mindset should be embraced. As discussed in both Chapters III and IV, nations will likely

⁴⁹³ United States Space Force, *United States Space Force Vision for Satellite Communications (SATCOM)* (Washington, DC: United States Space Force, 2020), <https://www.spaceforce.mil/Portals/1/SATCOM%20Vision%20Paper.pdf>.

⁴⁹⁴ Mallory Shelbourne, "Navy's 'Project Overmatch' Structure Aims to Accelerate Creating Naval Battle Network," *USNI News* (blog), October 29, 2020, <https://news.usni.org/2020/10/29/navys-project-overmatch-structure-aims-to-accelerate-creating-naval-battle-network>.

seek to maintain some degree of strategic independence in space, but full strategic independence remains cost prohibitive for most nations. Recognition of this reality will allow allies and the U.S. to allocate resources more efficiently. Interdependence and burden sharing will allow individual allies to leverage coalition assets that on their own would be cost prohibitive to develop domestically, while allocating limited resources to their nation's specific technological bases. For example, Japan and Australia would be well suited to continued development of CubeSats and CubeSat launchers, while Germany could focus its efforts on its highly regarded SAR satellite reconnaissance program.

C. SUGGESTIONS FOR FUTURE RESEARCH

The case study approach of this thesis was used to analyze and assess the best overall structure for allied space cooperation with existing U.S. allies, ultimately determining a global coalition structure to be most beneficial. The specifics of the structure, however, were outside the scope of this work. Therein lies an opportunity for further research to determine a specific framework and parameters for establishing a global space coalition structure. General guiding principles and policies are proposed in section B, but these policies should be expanded upon. What are the challenges or feasibilities of managing a cloud-based infrastructure to support the magnitude of a global space coalition? Additionally, the issue of burden sharing and the benefits of interdependence within space coalitions appear to be accepted from a surface level analysis. However, further research into a cost-benefit analysis and the opportunity costs associated with seeking true strategic independence in space, rather than relying upon allies, would be of merit to future discussions on space cooperation.

The difference between a treaty ally compared to a strategic partner is discussed in the second chapter of this thesis. Six formal treaty allies are addressed throughout this work. However, in Europe, Asia, and the Middle East, other nations like Italy, Spain, Taiwan, India, and Saudi Arabia have space capabilities that might be considered by the U.S. for inclusion in joint space efforts. These opportunities should be viewed in line with the Space Force's three Lines of Effort (LOE) outlined in its 2021 campaign support plan. These LOEs seek to expand the U.S.'s allied and partner relationships, while strengthening

and leveraging nascent allied and partner opportunities to ensure that in the space domain, the U.S. is the—partner of choice.⁴⁹⁵ The plan specifically calls for exploring relationships with “countries who may not project power globally or unilaterally, provide niche capabilities/access, or may deliberately disrupt a strategic competitor’s strategy.”⁴⁹⁶

India for example, is certainly a country which could disrupt the PRC’s regional strategies. Chapter IV highlighted the importance of the Indo-Pacific to the United States, its designation as the priority theater, and the resulting challenges from China’s rise. While not an ally, India is a major player in the Indo-Pacific, both as a regional power and a proven space power. In the maritime domain, the USN has increased its bilateral cooperation with India over the last decade. This increased maritime cooperation begs the question of when and if the U.S. will begin to cooperate with India in military space endeavors, beyond the sharing of SSA data. Admittedly, however, this is likely to be complicated by current laws like the Countering America’s Adversaries Through Sanctions Act (CAATSA).⁴⁹⁷

Finally, what opportunities exist for a U.S.-led global space coalition to assist emerging space programs, through technical expertise or technology transfer, in a similar fashion as institutional investors provide seed money to startup companies? Is there a long-term strategic benefit to allowing membership of nations which may not be able to contribute at the moment, but could allow access for ground control locations or launch sites? This is not to imply that this policy is the best way forward, or even a feasible policy option. It is simply meant to address the fact that space activity is no longer constrained to the major global actors. While this thesis addresses the role of U.S. allies and their possible contributions to various space coalition structures, little if any research is available addressing U.S. strategic partners and other emerging space actors. This research will likely

⁴⁹⁵ United States Space Force, *United States Space Force Campaign Support Plan: Expanding, Strengthening, and Leveraging Global Partnerships* (Washington, DC: United States Space Force, 2021), 3.

⁴⁹⁶ United States Space Force, 10.

⁴⁹⁷ Richard M. Rossow, “U.S.-India Defense Ties: Rebalancing the Indo-Pacific,” *Adapt and Advance: A Refreshed Agenda for U.S.-India Relations* (blog), February 11, 2021, <https://www.csis.org/blogs/adapt-advance-refreshed-agenda-us-india-relations/us-india-defense-ties-rebalancing-indo>.

require investigation into data sharing agreements, classification issues, and International Traffic in Arms Regulations (ITAR).

D. CONCLUSION

Over the next decade, maritime and space strategy of the U.S. will build upon doctrines such as the Tri-Service Maritime Strategy and the *United States Space Force Vision for Satellite Communications (SATCOM)*, seeking to increase allied cooperation, expand deterrence and leverage the pooling of resources. The chapters in this work tackled the issue of how best to approach allied space cooperation to enhance USN operations in great power competition with Russia and China. Each of the U.S.'s allies bring different capabilities and limitations to the table concerning an allied space coalition. However, in the three missions addressed (communications, MDA, and METOC), each of the six allies have the capability to augment or have already begun augmenting at least one of the three mission areas currently serviced primarily by the U.S.'s domestic space capability. By examining six of the U.S.'s strongest allies in space, three in each major region of competition, this thesis finds a global space coalition to be the greatest advantage for the USN and entire U.S. military to gain a strategic advantage over its peer competitors. A global space coalition structure will generate the greatest counterspace deterrence, reduce resource costs, and produce the force multiplier the military needs, while helping to strengthen the military space programs of all participants.

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