US-South Korea Relations in Space: A New Era for Partnership

By Katherine Melbourne and Sam Wilson

Introduction

Reaching its 70th anniversary in 2023, the alliance between the United States and South Korea, or the Republic of Korea (ROK), has entailed extensive military and defense collaboration. Such collaboration, however, has not typically extended to outer space. Policy restrictions have complicated projects between the two countries, which resulted in South Korea turning to other nations to partner with in space. Historically, this included Russia, which launched many South Korean satellites and assisted with developing South Korean space-launch vehicles in the 2000s and 2010s.

The limited nature of US-South Korea space collaboration seems to be changing, including for defense and security applications. Recent diplomatic and official engagements between the two countries reflect a heightened focus on US-South Korea relations in space. US President Joe Biden and South Korean President Yoon Suk-yeol issued a joint statement in May 2022 outlining the goals and commitments of the bilateral "Strategic Economic and Technology Partnership."[1] The presidents emphasized the exchange of expertise across many research areas with an explicit call to strengthen cooperation in space.

Also, in the spring of 2022, representatives of the US National Aeronautics and Space Administration (NASA) and the ROK Ministry of Science and ICT (MSIT) signed a Joint Statement of Intent for Cooperation on Space Exploration and Science.[2] The statement was followed by the MSIT vice minister's visit to NASA in January 2024 and the NASA deputy administrator's visit to Korea six months later.[3] Military space cooperation is also a growing focus. Notably, the US Space Force established a field component in South Korea (SPACEFOR-KOR) in 2022, and the commander of the US Space Command (USSPACECOM) visited South Korea to discuss US-South Korea space and missile defense in April 2024.[4]

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These engagements build upon South Korea's ambitious pursuit of a space program and the accumulation of successful efforts in space in recent decades. Despite getting a later start than other, more established space powers, the country has achieved a myriad of important milestones in space since it entered the field in the late 1980s with the establishment of a national aerospace research institute.[5] In 1992, the first South Korean satellite began operations, launching with the French company Arianespace. Three decades later, South Korea became one of a limited number of nations with indigenous orbital launch capabilities after its launch and deployment of a satellite from its Nuri rocket, also known as Korean Space Launch Vehicle-II (KSLV-II). Making strides toward deep space exploration, South Korea designed and built Danuri, a lunar orbiter mission on orbit since December 2022.[6] Additionally, with the launch of two reconnaissance satellites in December 2023 and April 2024, respectively, South Korea is challenging North Korea by demonstrating its ability to become a regional watchdog in space.[7]

Despite limited space collaboration between the two countries in the past, the future of US-South Korea space relations is ripe with potential for mutually beneficial collaboration, accompanied by some challenges that, if properly understood, are surmountable. This paper will assess such opportunities in detail by examining the history of space cooperation between the two countries, South Korea's policy objectives in space, areas of current and potential future cooperation, and extant challenges to the US-South Korea partnership in space.

Historical Context of the US-South Korea Space Cooperation

Cultivating US-South Korea space cooperation requires understanding the foundation of the bilateral relationship in space over the past few decades. Due to ties between missile technology and space-launch capabilities, South Korea's development of space capabilities had a slow start, constrained by international regulations and policies. Starting in the 1970s, the United States and South Korea entered into an agreement that authorized exchanging details on US missile technology while restricting the range and payloads authorized for South Korean missile launches.[8] Although the primary motivation of these restrictions was to limit the range and destructiveness of South Korea's missile strike systems to prevent crisis escalation, it also had the effect of restricting South Korea's space launch technology development, including preventing the use of solid fuels in rockets.[9]

More than two decades later, South Korea joined the international Missile Technology Control Regime (MTCR) in 2001, spurring the United States and South Korea to revisit and revise their original agreement on missile technology exchange.[10] South Korea's expanding ambitions in space remained hindered by the revised missile control agreement, however, as the United States was restricted from helping South Korea develop space-launch capabilities. South Korea instead turned to Russia to develop a joint orbital launch vehicle, Naro-1, that made a successful mission in 2013.[11] In 2021, just before President Yoon took office, the United States and South Korea once again revised their agreement on sharing missile technology, allowing for technology exchange between the two countries to include assistance on launch-vehicle development.[12] South Korea then became one of the few states with independent launch capabilities when its Nuri rocket launched a satellite into orbit in June 2022.[13] The revisions also allowed South Korea to develop rockets with ranges far exceeding the Korean Peninsula, and some experts suggest that the scrapping of the guidelines was also motivated by US-China strategic competition and an increasing focus on defense-industrial cooperation between the United States and its allies.[14] The shifting political and regulatory environment is creating more opportunities for US-South Korea space collaboration. The United States is continuing to authorize more security-related exports by changing historically strict policies. This includes a policy change in 2023 that allowed for increased satellite technology sharing with MTCR members.[15]

South Korea's Policy Objectives in Space

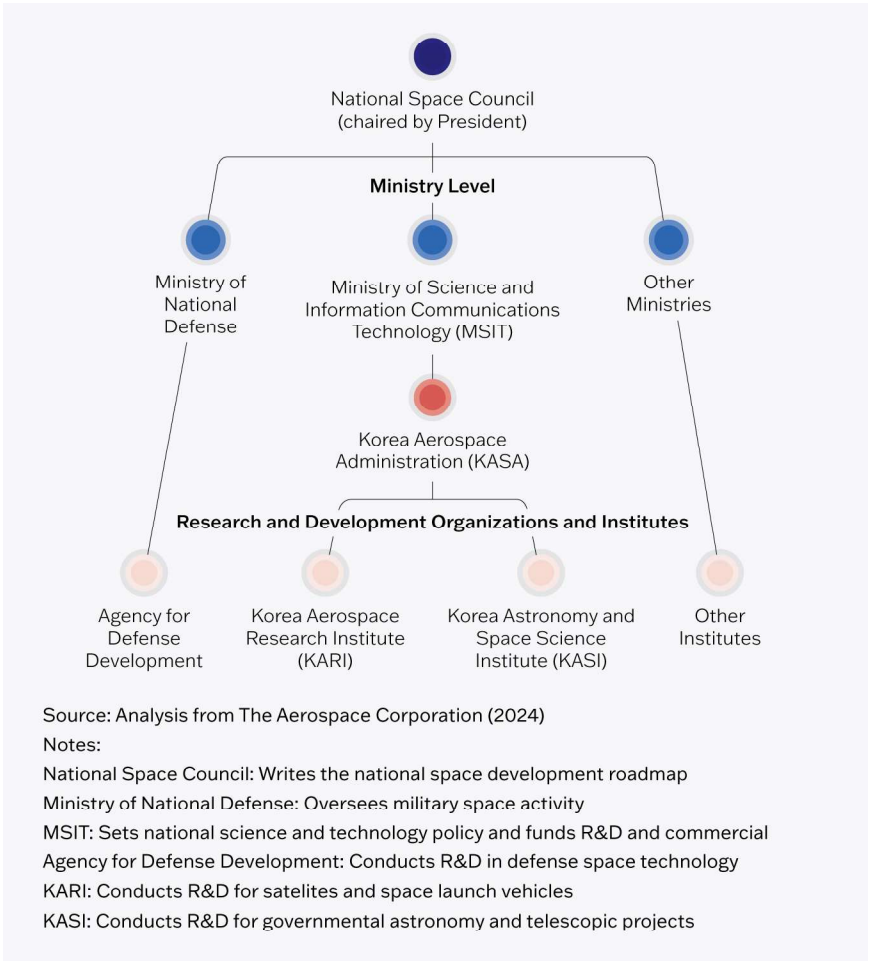
After taking office in 2022, President Yoon laid out a clear vision for the South Korean space industry and issued the country's fourth Space Development Promotion Basic Plan, approved in December 2022. Previous basic plans were issued in 2007, 2012, and 2018 and include national strategies for space that extend far beyond any one presidential administration. The first two plans focused on satellite technology development and creating national launch services, with the goal of building the foundation for future space exploration and the cultivation of a globally competitive national space industry.[16] With increasing experience and growing expertise, the country was able to expand to more specific and ambitious

objectives in its third basic plan, which guided South Korea to its first successful indigenous space launch. This plan also allowed the country to make progress on longer-term goals such as lunar exploration and the development of a navigation satellite constellation.[17] The fourth basic plan is based on the same foundational theme that space provides national economic benefits and presents an opportunity for South Korea to participate in space on a global stage. It also includes initiatives started in past plans—in particular, a growing investment in the Korean Positioning System (KPS), which underwent initial studies as part of the third basic plan and has nearly doubled its share of the total South Korean space budget from 2022 to 2024.[18]

However, the fourth basic plan is uniquely bold in its stated goals. South Korea aims to become a globally recognized space power, and the country is demonstrating its commitment to missions that will require significant technological advancements, a restructuring of the organization of its space and science agencies, and increased spending to foster growth in the space sector compared to past basic plans. Specific targets include a robotic landing on the Moon in 2032 and on Mars in 2045, a doubling of the government's space investments by 2027 (up to KRW 1.5 trillion, or about USD 1.1 billion), and focusing on private space industry growth. Regarding the latter, the fourth basic plan aims for South Korea's share of the total global space revenue to grow to 10 percent by 2045.[19]

The most notable policy change is the establishment of the Korean AeroSpace Agency (KASA), which is charged with managing the national civil, commercial, and military strategies for space and helping align research and development (R&D) efforts with the nation's long-term goals in space. KASA will oversee the existing Korea Aerospace Research Institute (KARI) and the Korea Astronomy and Space Science Institute (KASI), and MSIT will oversee KASA at the ministry level. The National Space Council, which has purview over the space portfolios of the various ministries, is chaired by President Yoon to ensure that the highest level of South Korean leadership is involved in space policy decisions. The structure of the government's space organizations is shown in Figure 1.

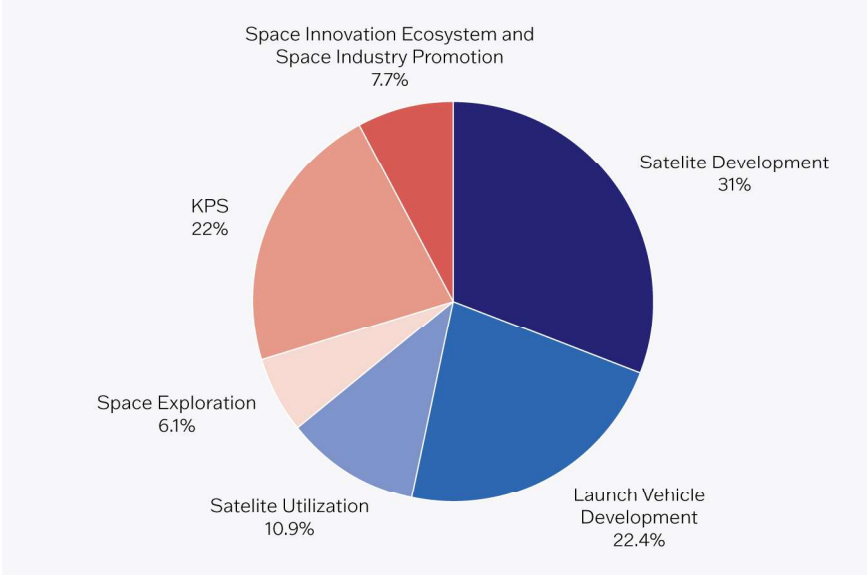
Figure 1. Space Organizations within the South Korean Government



Source: Analysis from The Aerospace Corporation (2024)
Notes:
National Space Council: Writes the national space development roadmap
Ministry of National Defense: Oversees military space activity
MSIT: Sets national science and technology policy and funds R&D and commercial
Agency for Defense Development: Conducts R&D in defense space technology
KARI: Conducts R&D for satelites and space launch vehicles
KASI: Conducts R&D for governmental astronomy and telescopic projects

Since the fourth basic plan was announced, the South Korean space budget climbed 19 percent from 2022 to 2023 and grew an additional 13.5 percent in 2024.[20] There are no signs of this investment slowing down. The ambitions for a thriving South Korean space economy are included in other national plans, in particular the New Growth Strategy 4.0 issued by the Ministry of Economy and Finance. Space is seen as a promising sector for growing the per capita gross national income.[21] Most of the space budget is spent on expanding the domestic market for space capabilities across various sectors of the industry. The breakdown is shown in Figure 2.

Figure 2. South Korea's 2024 Space Budget



Cultivation of Domestic Private Space Industry

Nearly a quarter of South Korea's space budget is spent on developing launch vehicles, for which the government is starting to turn toward the industry. While some of these funds are going toward the initial design of the KSLV-III, the third-generation South Korean launch vehicle that will take their lunar lander to the Moon by 2032, some funds are going toward ongoing launch technology transfer efforts.[22] Nuri, South Korea's second-generation orbital-launch vehicle, launched successfully for the first time in October 2021. Shortly before, the South Korean government announced its intention to transfer the system's technology to commercial partners.[23] Hanwha Aerospace was selected to receive support from KARI as part of the Korea Space Launch Vehicle Advance Project, which leads planned Nuri launches from 2022 to 2027.[24] The private industry, including Hanwha Aerospace, has been involved in South Korean space ventures from the beginning; the original construction of the Nuri rocket was made possible by the contributions of many commercial partners.[25] The South Korean government will continue to set targets for the industry to achieve—the most recent being the development of a reusable rocket that can send one-kilogram payloads to low Earth orbit (LEO) for USD 1000 per kilogram by the mid-2030s.[26] Having the industry take the reins of the overall launch effort—from researching launch technologies to managing launches—is motivated by the desire to increase the reliability of launches while decreasing their cost.

South Korea has actively worked to transfer payload technology to commercial partners as well. KARI has traditionally led the design and manufacturing of 500kg, medium-sized satellites, but Korean Aerospace Industries (KAI) has been chosen to take over.[27] The selection of KAI means more progress toward South Korea's goal of exporting space capabilities, as the states importing South Korean airplanes from KAI are also interested in acquiring satellites and available space data.[28] Hanwha Aerospace is also part of the payload technology transfer and is interested in inter-satellite-link technology, like that used in Starlink, for its 2000-satellite LEO constellation planned for 2030.[29]

The transfer of satellite technology in recent years has been led by the government-sponsored Korea Advanced Institute of Science and Technology (KAIST) and is just one example of the shift from relying on state-funded facilities for R&D to establishing joint facilities with academia and industry. President Yoon initiated the "Triangular Cluster" concept in March 2024, promising government support for space facilities by private industries throughout the country.[30] The cluster is intended to help achieve President Yoon's goal of having KRW 100 trillion (around USD 74.7 billion) in private investments in the South Korean space industry and the creation of 250,000 space-related jobs by 2045. Encompassing different geographic hubs for various sectors of the space industry, the triangular cluster consists of Daejeon leading space R&D efforts, South Jeolla Province leading launches, and South Gyeongsang Province leading manufacturing and testing.[31] The cluster concept has been used to support the commercial growth of other South Korean sectors of strategic interest, including the semiconductor industry, and demonstrates the country's commitment to its stated national goals.[32]

Restructured Civil Space Research Authorities

Keeping with the goal of growing South Korea's role as a major global actor in space, the establishment of KASA will contribute significantly to US-South Korea relations in space. After several years of preparations, KASA became the newest organization within the South Korean space governance structure in May 2024. Responsible for fostering the commercial space industry and developing and executing national space security strategies, including the

fourth basic plan, KASA will function as the "control tower of national space affairs and international cooperation."[33] KASA will be the umbrella organization for KARI and KASI, developing policies that directly inform the R&D choices made by the two space research institutions. The vision of KASA is to guide South Korea to "becoming the top five spacefaring nations in the world and making aerospace sector a national main industry" through expanding domestic investment in space and raising the profile of South Korean commercial companies to a global stage.[34] This includes moving from limited participation in international cooperative space efforts to assuming greater leadership in these efforts.

The establishment of KASA is crucial to growing the US-South Korea relationship in space. KASA is modeled after NASA, and the first KASA administrator, Yoon Young-bin, is a former NASA executive.[35] These connections could lead to close ties between the two agencies as they look forward to future collaborations. Additionally, KASA's positioning within South Korea's space governance provides clarity when communicating with international space partners by housing policy and strategy within one organization. South Korea's adaptation of a whole-of-government approach to space was recommended in previous analyses of the US-South Korea space relationship, and KASA has fulfilled that need.[36] With the lines of communication open between the United States and South Korea—and now NASA and KASA—the two countries can focus on the areas of space in which a bilateral partnership would be most impactful for both states.

Promising Areas for Continued and Future Partnership

The United States and South Korea each offer unique strengths in technology development and space capabilities. The opportunities for mutually beneficial partnerships in space include civil and military programs and span goals that can be achieved at any time between the next few years and the next few decades. These opportunities could take the form of diplomatic efforts, information sharing, commercial partnerships, and combined capabilities. Additionally, a summary of the working groups, agreements, and joint statements relevant to space mentioned in this paper is shown in Table 1.

Table 1: US-South Korea Working Groups, Agreements, and Joint Statements Relevant to Space

Agreement, Statement, or Working Group	Date of Establishment	Main Purpose	Agencies, Leaders, and Organizations Involved
Scientist-in-residence personnel exchange	2009	Space Science	• US National Oceanic and Atmospheric Association (NOAA) • Korean Space Weather Center (KSWC)
Memorandum of Understanding (MOU) on sharing space situational awareness data	September 5, 2014	Security	• US Department of Defense • ROK Ministry of National Defense
South Korea signs the Artemis Accords	May 24, 2021	Space Exploration	• NASA • ROK Ministry of Science and ICT
Joint statement on civil global navigation satellite systems cooperation	May 26, 2021	Security and Civil	• US Department of State • US National Coordination Office for Space-Based PNT • ROK Ministry of Science and ICT • ROK Ministry of Foreign Affairs
MOU on forming a joint space policy consultative body	August 27, 2021	Security	• US Space Force • ROK Air Force
US-ROK Leaders' Joint Statement on Strategic Economic and Technology Partnership	May 21, 2022	Governance	• US President Joe Biden • South Korean President Yoon Suk-yeol

GPS-KPS Technical Working Group	March 20, 2023	Security, Civil, and Commercial	• US Department of State • US Department of Commerce • US Space Force • US Coast Gaurd • ROK Ministry of Science and ICT • ROK Ministry of Foreign Affairs
Joint Statement of Intent for Cooperation on Space Exploration and Science	January 29, 2024	Space Exploration	• NASA • ROK Ministry of Science and ICT
Joint Project Agreement Ocean Research Panel Workshop	June 2024	Environmental Science Research (using satellite data)	• Various US and South Korean academic institutions • NOAA • Korea institute for Ocean Science and Technology
Joint Statement to Advance Aerospace Cooperation	September 22, 2024	Space Exploration	• NASA • KASA

Security and Civil Partnership Opportunities

Space situational awareness (SSA) is a capability that contributes to space security, and there has been explicit US-South Korea information sharing of SSA for a decade. A 2014 agreement between the US Department of Defense (DOD) and the ROK Ministry of National Defense (MND) called for exchanging "higher-quality and more timely space information" from the United States for satellite positioning and radio-frequency emission information from South Korea.[37] Space surveillance capabilities were also a key focus of the 2021 space security agreement between the US Space Force and the ROK Air Force.[38] This joint effort was put into action later that year with a bilateral drill designed to test SSA information-sharing pathways. The US-South Korea commitment to joint SSA is strong, but developing independent SSA capabilities remains a

priority for South Korea. KASA's space policy strategy includes the development of the Korean Integrated Space Situational Awareness System (K-SSA) for managing both public and military assets.[39] This builds off the satellite monitoring unit set up by the ROK Air Force in 2021 with the goal of developing ground-based lasers for a robust space tracking system by 2030.[40] With the United States' demonstrated commitment to space security through cooperation with South Korea, the US-ROK alliance can leverage US leadership and expertise in SSA to continue building South Korea's independent capabilities. Additionally, the growing emphasis on cislunar SSA provides another prime opportunity for US-South Korea collaboration that will help both countries achieve their goals of expansion toward the Moon.

Position, navigation, and timing (PNT) capabilities are essential not only for civilian and military global location services but also for technologies under development, including the rapidly expanding industry around autonomous vehicles. South Korea first established a steering committee to determine the requirements and scope of its KPS under the third basic plan for space in 2018.[41] Since then, the country has approved a proposed KRW 3.72 trillion (about USD 3.3 billion) for a project to design, launch, and operate eight satellites in geostationary orbit (GEO) by 2035.[42] The first launch is expected to take place in 2027 after completing the development of the satellite structure system in 2025. Notably, KPS made up about 12 percent of South Korea's space budget in 2022 and comprise about 22 percent in 2024.

KPS will have far-reaching impacts on South Korea and can greatly improve US Global Positioning System (GPS) services as well. In addition to cultivating commercial capabilities by contracting with South Korean companies for KPS satellite design, the infrastructure needed to operate, communicate with, and receive signals from KPS, as well as the accelerated technology development that will happen when KPS comes online, will help accelerate the growth of the private space industry in South Korea.[43] Although the motivation for KPS is largely domestic, South Korea is intentionally designing KPS to be interoperable with GPS capabilities to augment existing services and provide redundancy in the region.[44] South Korea is receiving US support to develop KPS in exchange for the country's participation in the Artemis Accords.[45] In March 2023, a GPS-KPS Technical Working Group was established and held its first meeting to discuss compatibility and interoperability between the two services.[46] This working group follows the commitments made in the 2022 joint statement between Presidents Biden and Yoon to support KPS development.[47] While there are several options for making GPS and KPS interoperable, the accuracy of both systems would be improved if used together.[48]

Hosting payloads could be an intriguing opportunity for US-South Korea defense space collaboration. In 2024, US commercial rockets launched a Norwegian spacecraft, which hosted US military satellite communication payloads.[49] This was the first time that a foreign spacecraft had active operational payloads from the US Department of Defense (DOD). The United States is also partnering with Japan, which will launch navigation satellites that will also host US national security payloads. Importantly, the DOD is transitioning to more proliferated satellite networks for missions, including missile warning and tracking. These proliferated assets typically comprise smaller and less expensive satellites. By moving from low numbers of expensive satellites for a mission to large numbers of cheaper satellites, DOD will have more opportunities to partner on shared capabilities with close allies and partners. The push toward proliferation may also make the department more willing to partner on shared capabilities because individual satellites will be less critical to the mission in a proliferated network than in a small constellation of satellites. South Korean spacecraft hosting US national security payloads should be an option that the United States and South Korea consider, including for missions of mutual interest such as missile warning and positioning, navigation, and timing.

Science Research and Space Exploration Collaboration

Protecting space assets through accurate space weather forecasting is another critical aspect of SSA, and the Korean Space Weather Center (KSWC) serves that purpose. Established in 2011 and now under the purview of KASA, the KSWC develops modeling capabilities and provides space weather-related warnings to satellite operators. South Korea has invested in its own space weather satellites, contracting with a domestic private company to launch a forecasting system focused on protecting South Korean military assets in space.[50] The KSWC director has emphasized the center's goal of strengthening their international partnerships.[51] To that end, South Korea is already a member of the International Space Environment Service (ISES), dedicated to international coordination of space weather data and warnings.[52] US-South Korea bilateral partnership includes KSWC scientists using data from US space weather satellites, particularly the Geostationary Operational Environment Satellite controlled by the National Oceanic and Atmospheric Association (NOAA).[53] Additionally, in 2009, NOAA and KWSC participated in a personnel exchange in which four South Korean scientists were scientists-in-residents at NOAA.[54] Both countries recognize the need for comprehensive space weather disaster management and issued updated national response plans in 2023.[55] Adequate preparation relies on quality research and data, and there is an opportunity to build on past space weather agreements and encourage more space weather expert exchanges between the two countries.

The United States and South Korea have the chance to strengthen their cooperation in space through environmental monitoring and forecasting as well. The desire to be an independent provider of Earth observation satellite-based forecasting spurred South Korea's entry into GEO in 2010 with the first launch of its Communication, Ocean, and Meteorological Satellite (COMS). Also known as the "Chollian" series of satellites, the follow-on payloads are designed to provide neighborhood-level weather monitoring services and help detect extreme weather-related events, including flooding and fires.[56] The United States and South Korea both have robust forecasting capabilities and recognize that exchanging ideas between scientists analyzing meteorological data is valuable for both countries. A recent example of such exchange took place in June 2024 when Seoul National University hosted a series of technical workshops for US and South Korean scientists to discuss techniques for extreme weather forecasting using satellite data.[57] Additionally, organizations from both countries are members of the Coordination Group of Meteorological Satellites (CGMS). Global users of CGMS data receive standardized, high-quality data, and members of CGMS are committed to helping each other if a member loses access to one of their satellite assets or data.[58] CGMS is now adding greenhouse gas monitoring to the organization's priorities, presenting an opportunity for the United States and South Korea to collaborate and take the lead in collecting and analyzing climate change data from space-based assets, building on a history of climate change cooperation between the two countries.[59]

Another category of observation satellites hosts synthetic aperture radar (SAR) systems to produce fine-resolution images of the Earth's surface. Launched in 2013, the Fifth Korea Multipurpose Satellite (KOMPSAT-5) is South Korea's first all-weather SAR satellite, used for mapping, predicting and tracking natural disasters, and managing resources.[60] The all-day, all-weather SAR technology is appealing to the military as well. The second of the five-satellite South Korean reconnaissance constellation, which launched in April 2024, used a combination of electro-optical/infrared (EO/IR) and SAR sensors.[61] Despite new advances in SAR, some South Korean scholars have noted that the country lags when it comes to EO/IR and SAR data-fusion technologies, advocating for South Korea to establish an "international technical cooperation system" to help fill technology gaps.[62] As the global research community tackles the challenges of SAR and EO/IR data-fusion processes, the US-South Korea scientific partnership could help accelerate progress. Paired with the increasing demand for high-resolution Earth observations—and, by extension, a growing market for this data—there is potential for enhancing US-South Korea commercial partnerships on SAR technology development and deployment.[63] Finally, South Korea could consider joining the International Coordination Group for Synthetic Aperture Radar

Missions (ICGS-SAR). NASA is a member, and South Korea's participation would further the country's global representation as an emerging expert on this essential space technology.[64]

Space exploration is another opportunity for South Korean global engagement. With a signatory status on the Artemis Accords, which details guidelines and principles for lunar and deep space exploration, South Korea is already working closely with the United States on international norms development. The fourth basic plan includes the envisioned dates of 2032 for a South Korean robotic lunar lander and 2045 for a Mars robotic lander. Both projects would offer plentiful opportunities for the United States to support South Korea's development of these capabilities. The United States has already participated in South Korean-led space exploration with the launch and commissioning of the Korea Pathfinder Lunar Orbiter (KPLO) in 2022, which carried a US-built instrument to the Moon.[65] US scientists will also have the opportunity to learn from data gathered by novel space missions led by South Korea. One example is the planned South Korean solar observer mission to the Sun-Earth Lagrange point L4, which would allow a unique vantage point of the heliosphere and improve understanding of solar activity.[66] The United States has proposed a similar mission to L4 to study solar wind.[67] In the Sun-Earth system, Lagrange points are areas where gravity is balanced between the Earth and the Sun. While there are no missions currently at L4, the fact that both countries have proposed missions to L4 means there are significant opportunities to collaborate for the betterment of both programs.[68] In September 2024, NASA and KASA signed a joint statement that mentioned their intention to explore L4 as well as providing some details on KASA's continued involvement in the Artemis program.[69]

Support for International Space Governance

With the US legacy of global leadership in space and South Korea's emergence as an international space leader, the next decade offers plentiful opportunities for joint space leadership on the world stage, particularly through the support of UN initiatives. Dedicated to ensuring continued access to space for all, the United States was a founding member of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS), which develops space governance under the auspices of the UN Office of Outer Space Affairs (UNOOSA).[70] Being a relative latecomer to the space sector has not prevented South Korea from being an active member in shaping the future of international space governance. Like the United States, South Korea has ratified the four main UN space treaties: the Outer Space Treaty, the Rescue Agreement, the Liability Convention, and the Registration Convention. As a fellow member of

UNCOPUOS, South Korea shares the US desire for free access to space, particularly for developing countries and emerging space-faring nations. South Korea actively supports these states by offering an International Space Training Program through KARI.[71] Part of the UN's Space 2030 Agenda encompasses encouraging the participation of women in space, and South Korea is supporting Space 2030 by leading UNOOSA's Space4Women three-year study to assess women's engagement in the global space industry.[72]

The United States and South Korea have similar overarching goals for the global space industry and are extensively involved in international space initiatives. Therefore, maintaining an open dialogue between the United States and South Korea on how the two countries envision future economic, scientific, and strategic success in space will ensure their work on international initiatives is aligned to enhance the global platform of both states.

Challenges to Partnership

While the opportunities for collaboration are promising, there are several challenges the United States and South Korea will have to consider—both individually and as allies—when furthering their space partnership. Some analysts suggest the US-South Korea space alliance would benefit most from a "train the trainer" model, where the United States is not focused on heavy-handed space capacity building in South Korea but rather empowers South Korea's independence in space through the exchange of technical expertise.[73] This aligns with South Korea's goals from its fourth basic plan. Additionally, there may be areas of space technology development in which South Korea would be well-suited to take the lead in the bilateral alliance. Given South Korea's expertise in 5G services and focus on expansion to 6G, the United States has an opportunity to partner with South Korea in terms of mobility, autonomy, and communication for space exploration.[74] As identified in the MSIT visit to NASA in January 2024, these technologies would be particularly useful for lunar rovers and communications, in addition to potential space traffic management applications.[75] The challenge is that South Korea must be able to build an adequate domestic market to achieve its targeted space milestones and maintain its indigenous space capabilities before the country can take on more responsibility in its partnership with the United States.[76]

South Korean leaders have espoused bold goals in space for the next two decades and are actively pursuing ventures that will help the country achieve those goals. However, investment and infrastructure alone are not the only problems to solve when building a thriving domestic space market. The government remains the primary customer of South Korean satellites and

space equipment, and it remains to be seen if government investment will be sufficient to sustain these bold directives for the industry. One example is the difficulty of getting competitive bids for space programs. For the development of KSLV-III, only one bidder participated and was ultimately chosen after a second bidder dropped out.[77] Additionally, South Korea still relies on foreign launch capabilities to achieve some of its goals in space. The South Korean reconnaissance satellite launched in December 2023 was brought to orbit by a SpaceX rocket rather than the domestic Nuri rocket, as SpaceX was more economical and reliable given the criticality of the satellite system to national security.[78] While the transition to having more domestic competition and using domestic providers for space services will take time, South Korea can continue to accelerate progress by instituting a policy to perform technology demonstrations on US missions to help test industry-made satellite components and help South Korean development processes remain agile.

South Korea's financial resources will be put to the test in the long term as well. Despite significant growth in their space budget as stipulated by the fourth basic plan, the South Korean space budget is less than one-fifth of Japan's space budget, a country with similarly ambitious goals in the industry.[79] Looking at relative spending compared to gross domestic product (GDP), South Korea's national spending on space is only 0.034 percent of its GDP, compared to the US space budget at 0.243 percent of the country's GDP.[80] Even if the rate of funding is sufficient to achieve national goals in space, experts warn that nurturing a growing space industry could give rise to similar challenges to those experienced at the start of the aviation industry in South Korea, where investments must be made years before profits can be expected.[81] A key part of the fourth basic plan is the economic benefit of space, which includes the domestic jobs the burgeoning industry will create. The creation of 500,000 space industry jobs is one of the country's many targets for 2045.[82] Aiming to make a 5000 percent increase in the number of employees in the domestic space industry—even over a 20-year period—would be a significant undertaking that the whole of the South Korean government should consider.[83]

Partnerships and Geopolitical Competition

Growing US-South Korea space cooperation is particularly important given the development of space coalitions or collaboration among competitor nations. After Russia invaded Ukraine, South Korea canceled satellite missions with Russia.[84] Moscow has now turned toward potentially supporting North Korea in its satellite technology development.[85] Around the same time as South Korea's successful reconnaissance satellite deployment in late 2023, North Korea launched its own reconnaissance satellite, possibly with help

from Russia, a move that the United States publicly condemned as a violation of UN restrictions on North Korean launch capabilities.[86] North Korea has also advanced its missile capabilities. Over the last ten years, China and Russia have also expanded their collaboration on space issues, including PNT and deep space.[87] Space security concerns also extend to Iran, with USSPACECOM warning of the bond between China, Iran, Russia, and North Korea in space.[88]

In addition to bilateral technology exchange between the United States and South Korea, the strong US-Japan alliance can be used as a foundation for a stronger US-South Korea-Japan trilateral relationship that includes a focus on space. An August 2023 meeting between the leaders of the United States, South Korea, and Japan named space as a key area of emphasis for this relationship. Japan has strong individual space capabilities and a history of partnering with the United States in space, with a particular focus on SSA.[89] With SSA being a focus for all three countries, South Korea and Japan would benefit from more direct information sharing. Historical tension between South Korea and Japan creates obstacles, but especially with the United States involved as a third partner, space offers a promising cooperative front to boost all three countries' individual capabilities and collective security.[90]

While the strength of the US-South Korea-Japan partnership should not be taken for granted, the expansion of this trilateral cooperation into space will be essential for Indo-Pacific regional security. In fact, missile-warning systems are a crucial area for US-South Korea-Japan trilateral cooperation in space, and the three countries should continue defining how information sharing can be more efficient and effective to ensure regional security.[91] In 2022, the three countries conducted a missile-defense exercise after holding a joint ministerial meeting, and at the end of 2023, a missile-warning data-sharing mechanism between the three countries was brought online.[92] As noted, deeper partnerships in this area could be particularly viable given that the United States is transitioning to large numbers of proliferated spacecraft for missile warning and tracking. For example, this could take the form of South Korea or Japan building their own satellites and hosting the US Space Development Agency's missile warning and tracking payloads. More broadly, as South Korea and Japan both have a deep bilateral alliance with the United States, the United States is in a unique position to continue encouraging dialogue and supporting a stronger bilateral relationship between South Korea and Japan. If South Korea fully embraces what President Yoon calls a "future-oriented" view of South Korea-Japan relations, both countries will be better protected from potential regional conflict.[93]

Nonetheless, tightening such cooperation—and the perception or reality of a US-led regional missile defense architecture—will undoubtedly result in strong pushback from Beijing, Pyongyang, and Moscow. In the context of increased

geopolitical competition and fault lines in the Indo-Pacific, policymakers in Washington, Seoul, and Tokyo will need to make sure their strategic communication about increased space cooperation is cohesive and convincingly responds to Chinese, North Korean, and Russian counter-narratives.

Looking to the Future

The mutual benefits of partnership, in addition to the vulnerabilities and values shared by the United States and South Korea, outweigh the risks posed by the challenges of cooperating in critical areas, including space.[94] The United States and South Korea have been key allies, but this partnership has not historically extended to space. This, however, is changing. South Korea aims to establish itself as a global space power by restructuring its space governance schema, promoting domestic commercial space capabilities, and laying the groundwork for ambitious space exploration goals. Meanwhile, the United States and South Korea have been leaning on their alliance legacy to ensure regional security by advancing space capabilities. The US-South Korea relationship in space is gaining momentum due to South Korea's renewed enthusiasm for space and recent space information-sharing agreements, military exercises, and bilateral scientific cooperation. Further, the US push toward proliferated space assets could create more opportunities for shared capabilities among allies and partners. Despite the challenges that lay ahead for South Korea's national space goals and international challenges that could arise, a strong US-South Korea space partnership would be mutually beneficial, and there is a plethora of cooperative avenues to pursue. There is no doubt that the next decade will be pivotal for defining the scope of US-South Korean partnerships in space.

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