The Tactical Utility and Strategic Effects of the Emerging Asian Phased Adaptive Approach Missile Defense System

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Executive Summary

The United States and Japan are jointly developing and deploying an integrated advanced regional missile defense system meant to counter threats from North Korea. North Korea possesses a large and diversified arsenal of short- and medium-range missiles that could strike Japanese cities and military bases in the event of a crisis and cause measurable damage. The missile defense system currently in place provides strong kinematic defensive coverage over Japanese territory. However, in general, the offense enjoys a strong cost advantage. It is impractical to deploy as many defensive interceptors as there are offensive missiles, which, in turn, limits the efficiency of missile defenses. It should be understood that regional missile defenses in the Asia-Pacific are neither capable nor expected to provide 100% defense. Rather, their goal is to provide sufficient capability to bolster deterrence and, should deterrence fail, to provide enough defense in the initial stages of a crisis to protect vital military assets. Additionally, U.S. and Japanese forces apparently also need to develop a better command and control architecture to operate the Asia-Pacific regional missile defense system. Finally, while the system is meant to defend only against regional threats, China has argued that the system might in the future be able to intercept Chinese ICBMs, thereby diluting its strategic deterrent against the United States. Maintaining effective defenses against North Korea while reassuring China will be one of the major challenges the U.S. and Japan face in their missile defense endeavor.

Introduction

Japan has invested significant resources into its missile defense plans. Its decision to pursue missile defense could be categorized as either a "threat-driven approach" meant to defend against missiles that North Korea (or China) might launch against it or as a "structure-driven approach" meant to revamp and strengthen the U.S.-Japan alliance and its military interoperability.[1] It is very difficult to parse and separate these two motives. In the last decade or so, however, the "threat" factor from North Korea seems to be the primary driver for Japanese choices. For example, in March 2016, the Japanese Defense Ministry announced that its "ground-based missile interception system [Patriot Advanced Capability-3] would be permanently deployed at a location in Tokyo following the Democratic People's Republic of Korea's increasingly frequent launches of ballistic missiles."[2] Table 1 below summarizes a timeline of major events that have occurred in the course Japan's pursuit of missile defenses.

The first major realization of a potential missile threat to the Japanese homeland occurred in August 1998, when North Korea flight-tested its Taepodong missile. The "Taepodong shock" changed the cautious attitude on missile defense that Japan had previously held. The incident measurably "altered the Japanese public's threat perception vis-à-vis Pyongyang, particularly because the missile flew over the Japanese mainland."[3] The 1998 North Korean missile test also "consolidated a large political support [leading to the passing of the U.S.-Japan Defense Guidelines legislation] not only allowing the government to officially launch a TMD [theater missile defense] co-research [project] with the U.S. but also to introduce domestically-produced reconnaissance satellites."[4] This reaction from Japanese politicians to the 1998 incident appears to have surprised even the Japanese Maritime Self-Defense Forces (MSDF) officers. Some of them had observed that "Such quick political decisions would have been virtually impossible had

the Taepodong incident not taken place—we are even 'grateful' to Pyongyang for 'helping' our cause to move on ahead with missile defense."[5]

Over the years, North Korea has conducted many test launches of its missile and satellite launch vehicles and has not shied from issuing threats towards Japan. In 2013, for example, the Korean Central News Agency (KCNA) of North Korea issued a commentary that said: "Japan is always in the cross-hairs of our revolutionary army and if Japan makes the slightest move, the spark of war will touch Japan first."[6] North Korea has approximately 1,000 missiles capable of reaching regional targets.[7] The most numerous missiles are the various SCUDs that can target South Korea. From the Japanese perspective, the *Nodong* missiles with their 1,500 km range are the most worrisome. North Korea also seems to possess a limited number of the *Musudan* missile with a range of 3,500 km which puts all of Northeast Asia and Guam and Okinawa under threat.

It should also be noted that North Korea could have as many as 20 nuclear weapons by the end of 2016, according to some analysts.[8] North Korean motives for procuring a missile arsenal is usually attributed to two reasons: "first is to compel the United States to alter its strategic calculus so that it is willing to accept a political settlement on the Korean peninsula conducive to regime interests…second is to be prepared to defend its interests in case of renewed military action on the peninsula, including ensuring survival of the regime."[9]

The first section of this paper will examine the status of the North Korean missile arsenal and its potential to threaten forward-deployed U.S., Japanese, and other allied forces. The second section of this paper will assess the state of readiness of the Asian Phased Adaptive Approach (APAA) missile defense system that Japan and the U.S. are establishing and its ability to offer limited defense against North Korean missiles. The section will also highlight the various command and control (C2) challenges the APAA missile defense system has faced until now. The third section will examine potential obstacles to the APAA, including Chinese concerns regarding the program. The final section will conclude with a recommendation on managing the threat from North Korea while attempting to preserve stability between the major players in the region.

Date	***Event***
September 1986	Chief Cabinet Secretary Masaharu Gotoba issues public statement on Japan's participation in SDI
1989	U.S. DoD/SDIO initiates WESTPAC Study. Mitsubishi Heavy Industries wins contract to lead study
1991	Japan decides to acquire PAC-2 systems. Japanese Air Self-Defense Forces began receiving these PAC-2 systems in 1998.
1993	North Korea fires four short-range missiles into the Sea of Japan
October 1993	SecDef Les Aspin offers Japan formal participation in TMD
December 1993	U.S.-Japan bilateral Theater Missile Defense

	Working Group (TMDWG) formed. TDMWG is seen as the foundation work that has now led to the joint development of SM-3 IIA
1995	Japanese government sets aside 20 million yen for TMD research. The Office of Ballistic Missile Defense Research (BMDR) established in the Japanese Defense Agency (JDA).
March 1996	China fires four DF-15 missiles in the vicinity of Taiwan
August 31, 1998	North Korea launches a Taepodong missile that flies over Japanese mainland
September 1998	Both Houses of Japan's Diet passes an unanimous resolution condemning North Korean missile launch and urges Japan to explore all means to secure the safety of the population.
August 16, 1999	U.S. and Japan sign MOU on joint R&D of SM-3 IIA missiles
2003	Japan decided to deploy the SM-3 Block IA on-board its Aegis-equipped ships.
December 19, 2003	Japan announces decision to deploy a missile defense system by acquiring PAC-3 and Aegis SM-3 IA
May 2006	The United States deploys a forward-based X-band radar at the JASDF's Shariki Garrison
2007	First battery of PAC-3 interceptors deployed to Iruma Air Base
2010	Japan decides to increase the number of Aegis-equipped BMD ships to six
December 2014	Second U.S. X-band radar deployed to Kyogamisaki
March 2016	Patriot Advanced Capability-3 to be permanently deployed in Tokyo

Table 1: Timeline on Japanese Missile Defense[10]

North Korea's Missile Arsenal and the Threat to Japan

Pyongyang's missile arsenal has progressively grown in both quantity and quality. In the 2000s, it was believed that North Korea had several hundred of missiles capable of reaching a wide range of locations in the Asia-Pacific.[11] In 2002, General Thomas A. Schwartz, Commander of United States Forces Korea testified before the U.S. Congress that North Korea had over 500 SCUD missile variants.[12] A 2009 report by the International Crisis Group suggested that North Korea had deployed over 600 SCUDs and around 320 Nodong missiles.[13] The 2010 United

States Forces Korea *Strategic Digest* states that North Korea, "with as many as 800 missiles in its active inventory…intends to increase its offensive capabilities."[14] Finally, very recent estimates by the U.S. Air Force have suggested that North Korea could have a total 1,000 missiles with around 100 SCUD launchers and 50 Nodong launchers.[15] While it is very difficult to obtain an accurate count of North Korean missiles, it is, however, possible to develop a rough estimate based on various publicly available sources. Table 2 below summarizes an estimate of the North Korean missile inventory collated from multiple sources.[16] It is should be noted that there are measurable discrepancies between these sources.

	Toksa (Viper/KN-02)	SCUD-B (Hwaseong-5)	SCUD-C (Hwaseong-6)	SCUD-ER	Nodong	Musudan (BM-25, Nodong-B, Taepodong-X, Mirim)	Taepodong-1 (Paektusan-1)	Taepodong-2 (Paektusan-2/Unha-2)	KN-08 (Hwaseong-13) (Road mobile ICBM)
Range (km)	120	300	500	700-1000	~1,500	> 3,000	1,500 to ~2,000	6,000 to ~10,000	~10,000
No. of Missiles		600-800			200-300	30 to ~50	20-30	~5	
No. of Launchers	~100	~40 to ~100			30 to ~50	25 to ~50		~6 (Road mobile version)	
Warhead Weight (kg)		1,000	770		700	650	500	650 to ~1,000	500 to 700
Status		Operational	Operational		Operational	Operational	Test Launch	Under Development	

Table 2: North Korean Missile Specifications[17]

While North Korea has an ambitious missile development program, its various missile capabilities are not equal. For example, its ability to successfully use an intercontinental ballistic missile (ICBM) or even an intermediate-range ballistic missile (range between 3,000 and 5,500 kilometers) is highly questionable, although recent successful space launches revive such concerns.[18] The 2013 U.S. Defense Department Annual Report on North Korea, for example, states: "…they [North Korea] unveiled an intermediate-range ballistic missile (IRBM) and a version of the NoDong medium range ballistic missile (MRBM) fitted with a cone-cylinder-flare payload at parades during the last three years. To date, the IRBM, like the new mobile ICBM, has not been flight-tested and its current reliability as a weapon system would be low." The report also says: "…a space launch does not test a reentry vehicle (RV). Without an RV capable of surviving atmospheric reentry, North Korea cannot deliver a weapon to target from an ICBM."[19]

However, North Korea's shorter range missiles, including various types of SCUDs and some Nodong missiles are more tested and presumed to have a higher likelihood of operational effectiveness. Figure 1 below shows the reach of these shorter range missiles. One of the largest worries for the U.S.-Japan-South Korean alliance is the concerns regarding the North's potential ability to use these missiles coupled with a nuclear weapon. The South Korean 2014 Defense White Paper, for example, speculates that "North Korea possesses about 40 kg of plutonium that can be used to produce nuclear weapons and it also assessed that a highly enriched uranium (HEU) program is underway. North Korea's ability to miniaturize nuclear weapons also seems to hav e reached a considerable level."[20] North Korea is also feared to have an arsenal of biological and chemical weaponry that could be delivered using its missiles. Its chemical weapons stockpile was estimated in 2005 to be between 2,500 and 5,000 tons.[21] Finally, even with mildly inaccurate conventional warheads, North Korean missiles could, in principle, substantially disrupt U.S. and allied military operations and impede logistics at U.S. bases in the region.

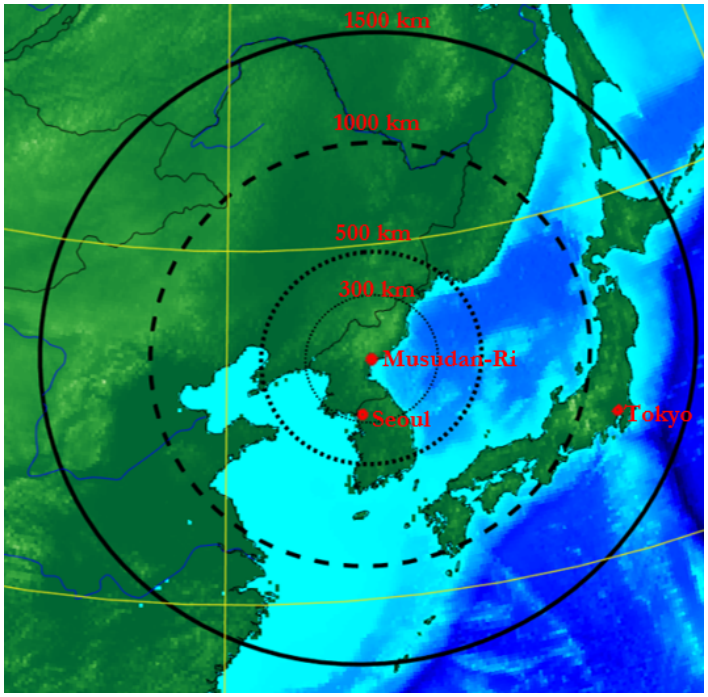

Figure 1: Notional Range of North Korean Missiles
Source: Author's Calculations

Japan's Missile Defense Capacity and Capabilities

While a large proportion of Japanese missile defense infrastructure is relatively new, Japan has been involved in missile defense related research and development since the mid-1980s. Under a 1985 licensing agreement with the United States, Japan produced Patriot missiles.[22] In 1998, the Japanese Air Self-Defense Forces (JASDF) received a total of 24 Patriot Advanced Capability-2 (PAC-2) batteries. In 1999, Japan decided to upgrade to the PAC-3 missile defense system at a cost of $1.7-$2.3 billion.[23] In 2007, the first battery of PAC-3 interceptors was deployed to Iruma Air Base near Tokyo.[24] The JASDF now possesses a total of 16 PAC-3 fire units located at Naha,

Kasuga, Gifu, and Iruma.[25] It should be noted that these PAC-3 batteries provide only terminal defense with very limited coverage.

A national missile defense shield for Japan is provided by its Aegis-equipped ships armed with the Standard Missile-3 (SM-3) Block IA interceptor.[26] In 2003, Japan decided to deploy the SM-3 Block IA on-board its Aegis-equipped ships.[27] In December 2005, the Japanese Cabinet and Security Council approved the joint development with the United States of the SM-3 Block IIA interceptor.[28] Tokyo might, eventually, also deploy an Aegis-Ashore SM-3 Block IIA system in mainland Japan similar to the system currently being deployed in Europe.[29] Japan tested the SM-3 Block IA missiles for the first time in 2007. An aegis-equipped Japanese warship, the JS Kongo, was used to track and intercept a mock target missile.[30] Presently Japanese Navy operates four Kongo class Aegis-equipped ships: Kongo, Chokai, Myoko, and Kirishma.[31]

In 2010, Japan decided to increase the number of Aegis-equipped BMD ships to six along with "four newly developed ground-based X-band radar sets (FPS-5), upgrades of seven radar systems (upgraded FPS-3), and modification of the Japan Air-Defense Ground Environment (JADGE), an automated integrated air-defense system."[32] To support Japan's missile defense mission, the United States has deployed, among other things, a PAC-3 battalion at Okinawa. The United States has also deployed a forward-based X-band radar at the JASDF's Shariki Garrison in May 2006.[33] A second X-band radar was deployed to Kyogamisaki in December 2014.[34] The United States presently deploys five Aegis-equipped missile defense-capable destroyers in Japan. In 2014, then U.S. Secretary of Defense Chuck Hagel announced that "in response to Pyongyang's pattern of provocative and destabilizing actions…I can announce today that the United States is planning to forward-deploy two additional Aegis ballistic missile defense ships to Japan by 2017."[35]

In light of all these investments, are current missile defense deployments sufficient in tracking and destroying North Korean missiles?[36] What sort of coordinated attack scenarios can the missile defenses hold up against? The discussion below will illustrate that the Asian Phased Adaptive Approach missile defense system fares quite well on the former, but poorly on the latter. Figure 2 below illustrates the defensive footprint (based on kinematic reach[37]) of an Aegis-equipped Japanese naval vessel with SM-3 Block IA interceptors.[38] The nominal footprint shown in the figure indicates that the SM-3 Block IA interceptors do provide good coverage over Japan, with some parts remaining exposed.

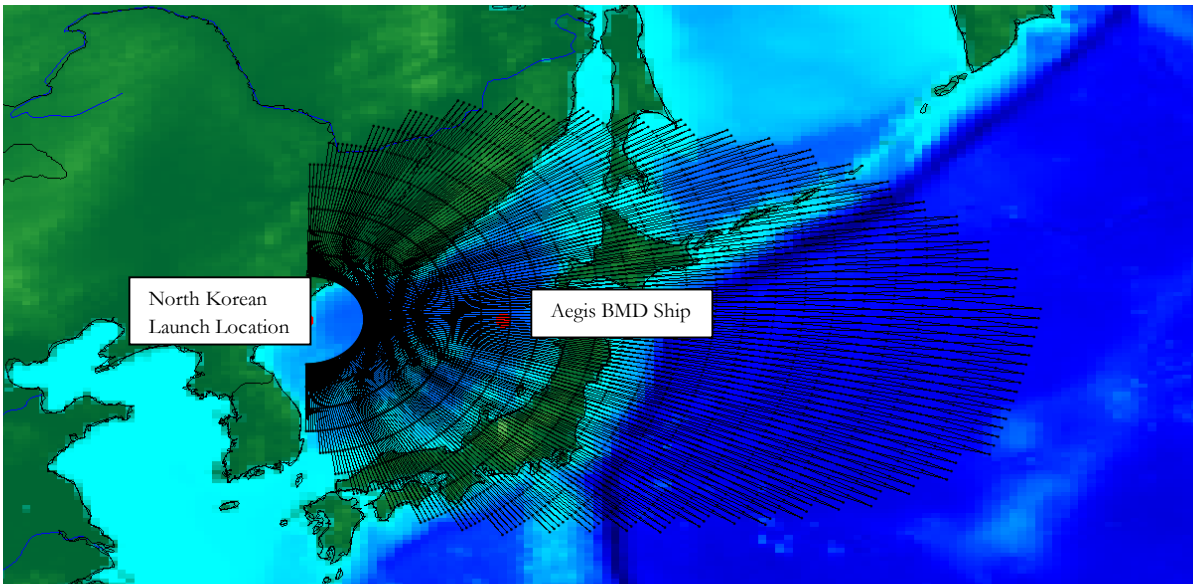

Figure 2: Nominal Defense Footprint of a Aegis-equipped Japanese ship loaded with SM-3 IA stationed in the Sea of Japan. The nominal footprint represents only the kinematic reach of the interceptor.
Source: Author's Calculations

However, a good footprint alone is not sufficient to execute missile defense missions. It should be understood that missile defense cannot provide a 100% guaranteed defense against every incoming missile. Rather, missile defenses are expected to intercept a significant fraction of an early salvo of missiles, thereby giving U.S. or Japanese forces sufficient time to respond. The presence of Japan's missile defense systems will not completely eliminate the missile threat that U.S. or Japanese forces may face from North Korea. Specifically, a single Aegis-equipped Japanese ship could, in theory, have as many as 90 interceptors dedicated to missile defense.

In operational reality, however, the numbers might be much lower.[39] Figure 3 below shows the leakage rate (the number of missiles that pass through the missile defense shield) for a given missile defense system. If one interceptor is committed for every missile, then to obtain a leakage rate of 10% (i.e., 1 in 10 missiles leak through), the SM-3 Block IA interceptors have to possess a 90% probability of kill. A 90% probability of kill is an extremely optimistic value to expect. If the SM-3 Block IA interceptors possess a reduced probability of kill of 70%, then to maintain the 10% leakage rate would require two interceptors per incoming target missile. In that case, a Japanese Aegis-equipped naval vessel with 60 SM-3 Block IA interceptors (the rest of the missile load in the ship can be presumed to be dedicated to other functions like air-to-air defense, anti-submarine warfare or cruise missiles, etc.[40]) would be able to able to defend against only 30 North Korean missiles under optimistic conditions. North Korea, on the other hand, is believed to possess 250-300 Nodong missiles that could conceivably be launched in a short time window.[41] The current inventory of four Japanese naval vessels would only be able to provide limited protection to critical civilian and/or military assets, particularly so if some of the ships are held back for later operations. A large North Korean attack salvo of around one hundred missiles could cause substantial damage to alliance forces or civilian populations. Nevertheless, the Aegis-equipped ships with SM-3 Block IAs along with the Patriot systems could offer a

sufficient capability to preserve important military assets, thereby strengthening overall deterrence.

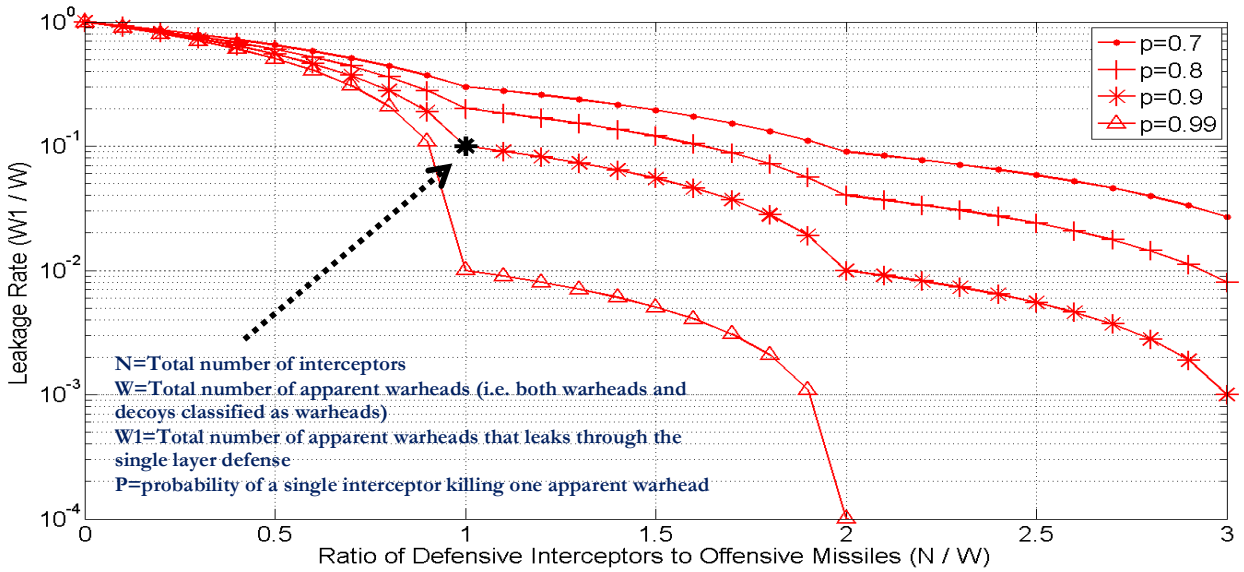

Figure 3: Leakage Rate of a Single Layer Missile Defense System
Source: Author's Calculations

Command and Control Challenges

While the disparity between the available number of missile defense interceptors in Japan's possession and offensive missiles in North Korea's arsenal is a cause for concern, equally worrisome is the performance of missile defense systems to date. There have been significant lapses in the command and control procedures of the system in the past when it was called upon to establish a shield over Japan.

For the past decade, Japan has been grappling with the process of establishing command and control procedures for defense in the event of a sudden missile attack. Beginning in July 2005, Japan amended its Self-Defense Forces Law to establish procedures that pre-delegated interceptor launch authority to the Japanese Self-Defense Forces in the event of a rocket launch by North Korea if it overflew Japanese territory.[42] This amendment permitted Japan's "defense minister to issue an order—in accordance with procedures approved by the Prime Minister—to destroy an incoming object so as to prevent the loss of lives or damage to property on Japanese territory."[43] In October 2005, the U.S.-Japan Security Consultative Committee issued a document titled "U.S.-Japan Alliance: Transformation and Realignment for the Future" that included provisions for bilateral and joint operational coordination.[44] As part of this initiative, the JASDF Air Defense Headquarters was relocated to Yokota Air Base where the United States Forces Japan (USFJ) is based.[45] This relocation was intended to foster greater data sharing and integrated decision making between U.S. and Japanese forces in the event of a missile attack. In 2007, Japan's Self-Defense Forces established the Joint Staff Office (JSO) to better coordinate operational requirements of missile defense. This action was motivated by the realization that "Joint [military] operations is also an essential foundation for effective BMD, because the MSDF's [Maritime Self-Defense Forces] Aegis vessels and the ASDF's warning and

surveillance systems and Patriot missile defense systems are all part of the Japanese BMD system, and these assets should be closely coordinated for time-sensitive missile defense operations."[46]

While all these actions cumulatively showcase a desire from the Japanese and U.S. forward-deployed forces to master the command and control cycle involved in missile defense interceptions, the real-world results have been less successful. In four instances to date, Japan and the United States have had an opportunity to demonstrate the system. In three instances (2006, 2009, and 2012), significant problems of command and control were uncovered.

In the 2006 instance:[47]

> Despite the U.S. forces informing the SDF of the third missile launch on July 5 at 4:59 a.m. and the MSDF Aegis destroyer [Kongo] being dispatched to the Sea of Japan, *Kongo's* radar failed to detect any trace of ballistic missiles. Taepodong-2 was estimated to have a height of 1,000 km, which, theoretically, was supposed to be visible on *Kongo's* radar after the launch, but because the missile never attained the necessary height or distance to be properly detected, it took some time for Japan to confirm that the third missile was indeed a Taepodong…and confused JDA officials kept asking each other, 'Was the launch a failure, or what?' It is speculated that the six other missiles had been Nodongs or Scuds, and *Kongo's* radar detected trajectories of half of those missiles…Some defense officials speculated that the reason why *Kongo* was unable to detect the missiles was because the U.S. government did not relay all of their information to the Japanese Aegis, subsequently fueling the suspicion that 'the U.S. does not trust us well enough.'[48]

In the 2009 instance:[49]

> On 4 April [2009] at 12:16, the FPS-5 phased-array radar at Iioka, Chiba Perfecture, detected an object above the Sea of Japan. This information was sent to staff at Air Defense Headquarters, Fuchu, Tokyo. In accordance with procedure, the staff reported verbally to other headquarters staff, using the phrases "Iioka detected" and 'SEW [Shared Early Warning] detected'. However, there was a misunderstanding. At that time, SEW had not detected the missile launch. The voice-based information was immediately disseminated to the local government through the Cabinet Secretariat. Once minute later, the Joint Staff Office checked SEW information and noticed that SEW had not detected the missile launch. Accordingly, they reported that the 12:16 launch information was false. Finally, at 12:20, the corrected information—stating that no missile had been detected—was disseminated to the local government. According to the after-action report of 2009, the human error happened because one staff had been wrongly convinced that both FPS-5 and SEW had detected the missile launch.

In contrast, the situation was reversed in April 2012:[50]

> On 13 April at 7:40 am, the MoD received SEW information from the US. However, it took time for other sensors to confirm the launch, to double check, and no Japanese sensors could detect it. For that reason, the GoJ's [Government of Japan] announcement of the missile launch was delayed for about one hour. Finally at 8:23,

> Defense Minister Naoki Tanaka announced the information at a press briefing, followed by a briefing by Chief Cabinet Secretary Osamu Fujimura at 8:37. The reason for this delay was that the GoJ had established a double-check principle to avoid the dissemination of false information, as had happened in 2009. In addition, in April 2012, North Korea's missile exploded immediately after the launch. In general, radar cannot pick up objects below the horizon…therefore, both the ground-based radar in Japan and the maritime-based radar of the Aegis vessel deployed in the Southern part of Japan could not detect the missile because it crashed before it rose above their horizon. This physical reality prevented the double-checking of the information released by the SEW space-based sensors.

Since then, the performances of the missile defense units have been tested twice. In December 2012, when North Korea launched a space launch vehicle, Japan was able to successfully disseminate early warning information to its local governments and between various missile defense military units quickly.[51] Most recently, in anticipation of the February 7, 2016, launch of North Korea's satellite launch vehicle, the Japanese Defense Minister, Gen. Nakatani, ordered Aegis-equipped missile defense warships and its PAC-3 missile defense units to, if needed, destroy components falling within its territory.[52] The report on the performance of the missile defense forces in these instances is still forthcoming. Its judgment would be extremely illuminating in understanding the performance of the Japanese missile defense forces. However, the various command and control failures highlighted above does force one to question if the system will function effectively in the face of a surprise North Korean missile attack.

China's Opposition to U.S. and Japanese Missile Defense Deployments

Chinese opposition to the deployment of missile defense in Northeast Asia by Japan and the United States falls under one of these reasons:[53] "(1) TMD cooperation with the United States would mark a qualitative upgrading of the U.S.-Japan alliance; (2) Provision of TMD-related missile technologies—such as propulsion and guidance—could contribute to a Japanese offensive ballistic missile program; (3) TMD cooperation with Japan could provide the technical and political basis for Japanese "remilitarization." Japan will first develop missile defenses (a 'shield') and then may develop offensive missile forces (a 'spear'); (4) Japanese deployment of upper-tier TMD could be used to defend Taiwan;[54] (5) TMD development may spark an arms race in Asia between China and Japan and consequently between Taiwan and China; (6) TMD and National Missile Defense (NMD) are closely related, so Japanese participation in joint development of TMD will ultimately assist the United States in the development of NMD; and (7) 'US-Japan cooperation on TMD will aggravate tensions on the Korean peninsula' and 'the nuclear and missile-related problems with Korea can only be settled by political means through dialogue.'"

Beijing has had an innate suspicion regarding U.S. missile defense deployments and U.S. intentions in East Asia. A recent Chinese military text, *The Science of Military Strategy,* has, for example, asserted that U.S. missile defense in Asia is "creating increasingly serious effects on the reliability and effectiveness of a Chinese retaliatory nuclear attack."[55] Chinese personnel argue that missile defense deployments in their neighborhood would fundamentally alter the

strategic balance and stability between the United States and China and, in turn, would force China to increase its nuclear arsenal. China (and Russia) has consistently argued that any missile threats from North Korea are a pretext to deploy missile defenses targeting them.[56] They contend instead that "political, legal and diplomatic means, to explore the possibility of gradually working out a global control system in prevention of the proliferation of missiles and related technologies, and to conduct extensive and non-discriminatory dialogue and cooperation" is the way to address such threats.[57]

Although Washington is undertaking a missile defense plan that it clearly states is driven by legitimate U.S. and allies' security considerations, China (and Russia) apparently have found it difficult to accept this U.S. articulation. Additionally, the United States has repeatedly pointed out that these systems do not and are not meant to alter strategic stability. For example, the recent U.S. Ballistic Missile Defense Review stated: "Engaging China in discussions of U.S. missile defense plans is also an important part of our international efforts…maintaining strategic stability in the U.S.-China relationship is as important to the administration as maintaining strategic stability with other major powers."[58] The 2010 Nuclear Posture Review also made similar commitments.[59] Conceivably, however, "in dealing with the US, prudent states are necessarily going to assume that its intentions are at best ambiguous, and more likely adversarial."[60] China (and Russia) tends to argue that even limited U.S. missile defense postures will over time accumulate increasing capabilities, and can therefore quickly convert such capability to a larger threatening posture.[61] Such logic can be observed directly in Chinese stated opposition to the deployment of U.S. missile defense radars in the region. Wu Riqiang from China's Renmin University, for example, suggests that "Beijing's biggest concern is that such [missile defense] radars will be deployed close enough to China to register the decoy-deployment process of strategic missiles…this prevents missile defense systems from being susceptible to mid-course decoy countermeasures, and should be seen as China's red line."[62]

Of course, in theory, U.S. missile defense systems in the Asia-Pacific could be reconfigured to offer limited defenses against Chinese short- and medium-range missiles. And, while North Korean missile threats permeate the discourse on Japanese missile defense, it is not inconceivable for it to maintain the potential to ramp capabilities against China if a significant threat perception arises.[63] Japan's ambassador Imai Ryuichi, for example, said: "…with all the debate and trouble TMD has caused in the SDF, it would be foolish to think that Japan spends enormous amounts of money to only defend against two or three North Korean Taepo Dongs."[64] However, such a reconfiguration would be of limited effectiveness given that China's deployed missile arsenal is one of the most extensive in the world.[65] China continues to modernize its missile arsenal and is also developing a number of newer and more capable offensive missiles.[66] China is believed to have around 1,200 short-range missiles. Its medium range-missile inventory could include as many as 400 CSS-6 missiles (with a range of 600 km) and around 85 CSS-5 missiles (with a range of 1,750 km).[67] China also possesses a significant number of other medium- and intermediate-range ballistic missiles.[68] These missiles could be targeted against U.S. forward-deployed forces, allied forces, and bases in the region.[69] Succinctly capturing this aspect of the tensions between the United States and China on missile defense, former U.S. Secretary of Defense William Perry said in 2000:[70]

> I share the Chinese concern over the deleterious effect of an arms race in the region, but I believe that if an arms race does get underway it will have been stimulated by the extensive deployment of missiles, not the deployment of missile defenses…I am today more pessimistic about the future of United States-China relations than I have been for several decades.

Presently, ranges of Chinese conventionally-armed missiles extend to U.S. bases as far away as Guam. Any debate on U.S. missile defense reductions in the region should, therefore, also involve a discussion of China's missile arsenal.

Conclusions

Recurrent North Korean provocations have and will continue to shift Japanese preferences on missile defense to a more capable system. However, missile defense come with inherent limitations that under the best circumstances will provide only limited protection. Also, while the need to limit provoking China influences Japanese defense decisions, including the procurement and deployment of missile defense equipment, unless there is substantial change in the perception of the North Korea threat, it seems that such concerns will play only a secondary role. A jointly operated U.S.-Japan defensive system could turn out to be crucial to defend Japan and U.S. forward-deployed forces from North Korean threats, and in the larger context, help to ensure broader regional security in the Asia-Pacific arena.

Notes

[1] Lars Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo* (Berlin: Lit Verlag, 2007), 364. A third possible explanation is lobbying by the defense industry in Japan. For an argument that suggests this explanation, see: Saadia M. Pekkanen, "Japan's Ballistic Missile Defense and 'Proactive Pacifism,'" in *Regional Missile Defense from a Global Perspective,* ed. Catherine McArdle Kelleher and Peter Dombrowski, (Stanford, CA: Stanford University Press, 2015), 217-237. While Japanese defense contractors with vested interests in missile defense co-development projects, such as Kawasaki Heavy industries and Mitsubishi Heavy industries, were pleased with the possibilities, other defense contractors were not. The Japanese government per its 2004 National Program Guidelines (NDPG) "cut spending in traditional defense equipment and systems in order to accommodate the large price tag of deploying BMD without increasing overall defense budget. Hence, Tokyo's decision to move on forward with BMD at a time when the defense budget continued to decrease crowded out other defense priorities, forcing firms unrelated to BMD co-development to seek alternative clients to make ends meet. For these defense contractors, BMD turned out to be a menace—not a savior of the dwindling defense industry." See: Kaori Urayama, *Missile Defense, U.S.-Japan Alliance and Sino-Japanese Relations, 1983-2007* (PhD Diss., Boston University, 2008), 151.

[2] Xinhua News, "Japan to Permanently Deploy Missile Interceptors amid Intensified Frequency of DPRK Launches," *Xinhua News Asia & Pacific Edition*, March 22, 2016, http://news.xinhuanet.com/english/2016-03/22/c_135212815.htm.

[3] Urayama, *Missile Defense, U.S.-Japan Alliance and Sino-Japanese Relations,* 146.

[4] Ibid., 30.

[5] Ibid., 154.

[6] Charlotte Meredith, "North Korea States 'Nuclear War Is Unavoidable' As It Declares First Target Will Be Japan," *Express,* April 12, 2013, http://www.express.co.uk/news/world/391376/North-Korea-states-nuclear-war-is-unavoidable-as-it-declares-first-target-will-be-Japan.
[7] John Schilling and Henry Kan, "The Future of North Korean Nuclear Delivery Systems," (Washington: US-Korea Institute at SAIS, 2015), http://38north.org/wp-content/uploads/2015/09/NKNF_Delivery-Systems.pdf.
[8] David E. Sanger, "With U.S. Eye on Iran, North Korea's Nuclear Arsenal Expanded," *The New York Times*, May 7, 2015, http://www.nytimes.com/2015/05/08/world/asia/with-us-eyes-on-iran-north-koreas-nuclear-arsenal-expanded.html.
[9] Brad Roberts, *On the Strategic Value of Ballistic Missile Defense* (Paris: IFRI Security Studies Center, Proliferation Papers 50, June 2014), 12.
[10] Michael D. Swaine, Rachel M. Swanger, and Takashi Kawakami, *Japan and Ballistic Missile Defense* (Santa Monica, CA: Center for Asia-Pacific Policy, RAND Corporation, 2001); Shanelle Van, *Ballistic Missile Defense in Japan: Process-Tracing a Historical Trajectory* (Durham, NC: Undergraduate Thesis, Sanford School of Public Policy, Duke University, December 2014); Xinhua News, "Japan to Permanently Deploy Missile Interceptors amid Intensified Frequency of DPRK Launches," *Xinhua News Asia & Pacific Edition*, March 22, 2016, http://news.xinhuanet.com/english/2016-03/22/c_135212815.htm; Sugio Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation* (Paris: IFRI Center for Asian Studies Security Studies Center, December 2012), 11, 17; Ministry of Defense, "Japan's BMD System"; Ministry of Defense, "Japan's BMD."; U.S. Department of Defense, "Second Missile Defense Radar Deployed to Japan," December 26, 2014, http://www.defense.gov/News/News-Releases/News-Release-View/Article/605330/second-missile-defense-radar-deployed-to-japan.
[11] Office of Secretary of Defense, Department of Defense, *Proliferation: Threat and Response,* January 2001, 9.
[12] Statement of General Thomas A. Schwartz, Commander In Chief United Nations Command/Combined Forces Command & Commander, United States Force Korea, Before the 107th Congress Senate Armed Services Committee, March 5, 2002, 8, http://www.globalsecurity.org/military/library/congress/2002_hr/schwartz0305.pdf.
[13] International Crisis Group, *North Korea's Nuclear and Missile Programs* (Seoul/Brussels: International Crisis Group, Asia Report # 168, June 18, 2009) 8, http://www.crisisgroup.org/~/media/Files/asia/north-east-asia/north-korea/168_north_koreas_nuclear_and_missile_programs.ashx.
[14] United States Forces Korea, *The New Korea. Strategic Digest 2010: Strategic Alliance 2015* (United States Forces Korea, October 2010), 11, http://www.osan.af.mil/shared/media/document/afd-101101-005.pdf. See also: Statement of General B. B. Bell, Commander, United Nations Command; Commander, Republic of Korea-United States Combined Forces Command; and Commander, United Sates Forces Korea Before the Senate Armed Services Committee, April 24, 2007, 7, http://www.globalsecurity.org/military/library/congress/2007_hr/070424-bell.pdf .
[15] National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat* (Wright-Patterson Air Force Base, OH: National Air and Space Intelligence Center, 2013); Schilling and Kan, *The Future of North Korean Nuclear Delivery Systems,* 10.
[16] For a conservative estimate, see: Markus Schiller, *Characterizing the North Korea Nuclear Missile Threat* (Santa Monica, CA: RAND Corporation, 2012), 66. While acknowledging some level of speculation, he suggests that there are only hundreds of SCUD B models, around 100 SCUD C models, a few dozen SCUD D/ER models, a few dozen Nodong, around two Taepodong-II, and a small number of Musudan missiles in North Korea's inventory. Furthermore, he argues that "only a small number of [North Korean] launch crews can be well trained…the lack of crew training will result in moderate results at best, with handling failures and low accuracy. If missile are produced in North Korea, they are not of excellent reliability and accuracy because of the lack of firing table creation and lot acceptance tests."
[17] Office of the Secretary of Defense, Department of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea. Annual Report to Congress* (Washington DC: Department of Defense, 2013), 19; Minis-try of Unification, Institute for Unification Education, *2014: Understanding North Korea* (Seoul: Research and Development Division, Institute for Unification Education, 2014), 193; Ministry of National Defense, Republic of Korea, *2014 Defense White Paper* (Seoul: Ministry of National Defense, 2014), Ch.1, 32, http://www.mnd.go.kr/user/mnd_eng/upload/pblictn/PBLICTNEBOOK_201506161152304650.pdf; Ministry of Defense, Government of Japan, *Defense of Japan 2015*, (Tokyo: Ministry of Defense, 2015), Ch.1, 20-22, http://www.mod.go.jp/e/publ/w_paper/pdf/2015/DOJ2015_1-1-2_web.pdf; International Crisis Group, *North Korea's Nuclear and Missile Programs*; Anthony H. Cordesman et al, *The Changing Military Balance in the Koreas*

and Northeast Asia (Washington DC: Center for Strategic and International Studies, 2015), 184, 187, http://csis.org/publication/changing-military-balance-koreas-and-northeast-asia; National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat*.

[18] Mark Landler, "North Korea Nuclear Threat Cited by James Clapper, Intelligence Chief," *The New York Times,* February 9, 2016.

[19] Office of the Secretary of Defense, *Military and Security Developments Involving the Democratic People's Republic of Korea. Annual Report to Congress,* 10-11. However, speaking about the Hwasong-13 (also called the KN-08), the Vice Chairman of the U.S. Joint Chiefs of Staff, Admiral James Winnefeld, said: "We believe the KN-08 probably does have the range to reach the United States." See: Bob Orr, "Differing Views of NK Nuclear Threat," *CBS News,* April 12, 2013, http://www.cbsnews.com/news/differing-views-of-nk-nuclear-threat/.

[20] Ministry of National Defense, *2014 Defense White Paper,* 32.

[21] Ibid.; J5 Strategic Communications Division, U.S. Forces Korea, *Strategic Digest: 2015* (U.S. Forces Korea 2005), 14, http://www.usfk.mil/Portals/105/Documents/Strategic_Digest_2015_Eng.pdf.

[22] Christian Science Monitor, "Japan Considers Building Missile," *Christian Science Monitor,* April 24, 1989, http://www.csmonitor.com/1989/0424/oconsid.html#; Karen Montague, *Japan's Ballistic Missile Defense Policies and Programs* (Washington DC: George C. Marshall Institute, Policy Outlook, June 2014), 1.

[23] Kenneth W. Allen et al., *Theater Missile Defenses in the Asia-Pacific Region* (Washington DC: Henry L. Stimson Center, June 2000), 62.

[24] Sugio Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation* (Paris: IFRI Center for Asian Studies Security Studies Center, December 2012), 11.

[25] Ministry of Defense, "Japan's BMD System," *Ministry of Defense, Government of Japan*, http://www.mod.go.jp/e/jdf/no31/specialfeature.html; Ministry of Defense, "Japan's BMD," *Ministry of Defense, Government of Japan*, http://www.mod.go.jp/e/d_act/bmd/bmd.pdf.

[26] "Japan Fleet BMD: Upgrades & UORs," *Defense Industry Daily,* November 10, 2015, http://www.defenseindustrydaily.com/up-to-387m-for-japanese-naval-abm-components-0807/.

[27] Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation,* 11.

[28] Ibid.

[29] Sam LaGrone, "Report: Japan Interested in Aegis Ashore for Ballistic Missile Defense," *USNI News,* September 16, 2014, https://news.usni.org/2014/09/16/report-japan-interested-aegis-ashore-ballistic-missile-defense.

[30] Simon Montlake, "Japanese Warship Tests Antimissile System," *The Christian Science Monitor,* December 18, 2007, http://www.csmonitor.com/2007/1218/p99s01-duts.html.

[31] Ministry of Defense, "Japan's BMD System"; Ministry of Defense, "Japan's BMD."

[32] Ibid.

[33] Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation,* 17.

[34] U.S. Department of Defense, "Second Missile Defense Radar Deployed to Japan," December 26, 2014, http://www.defense.gov/News/News-Releases/News-Release-View/Article/605330/second-missile-defense-radar-deployed-to-japan.

[35] Zachary Keck, "Japan's Building 2 Aegis Destroyers," *The Diplomat,* July 23, 2014, http://thediplomat.com/2014/07/japans-building-2-aegis-destroyers/. See also: Sam LaGrone, "Navy Moving Two Additional BMD Destroyers to Japan," *USNI News,* October 17, 2014, https://news.usni.org/2014/10/17/navy-moving-two-additional-bmd-destroyers-japan.

[36] Missile defense, arguably, holds more value than in its intrinsic ability to intercept and destroy an incoming missile. It also retains strategic purposes in that it: "(1) Creates uncertainty about the outcome of an attack in the mind of the attacker; (2) Increases the raid size required for an attack to penetrate, thereby undermining a strategy of firing one or two and threatening more, thus reducing coercive leverage; (3) Provides some assurance to allies and third party nations of some protection against some risks of precipitate action by the aggressor; (4) Buys leadership time for choosing and implementing courses of action, including time for diplomacy; (5) Reduces the political pressure for preemptive strikes; (6) Helps to preserve freedom of action for the United States and its partners by selectively safeguarding key military and political assets; (7) Increases time and opportunity to attack an adversary's missile force with kinetic and non-kinetic means, potentially eliminating his capacity for follow-on attacks or decisive political or military effects; (8) Reduces or eliminates the vulnerability of allies, thus reinforcing their intent to remain in the fight." However, even to serve these strategic purposes, missile defense has to possess some level of operational efficiency. See: Brad Roberts, *On the Strategic Value of Ballistic Missile Defense*, 22-23. For a more

Japanese viewpoint on use of missile defenses, see: Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation*, 23-24.
[37] Kinematic reach is the ability of the interceptor to reach the same region in space occupied by the target missile at the same time. In some circumstances it might not be sufficient to intercept and destroy the target missile.
[38] There no official record from either the United States or Japan on the burn-out velocity of the SM-3 IA interceptors. For the purposes of this paper, SM-3 IA interceptors are assumed to have a burn-out velocity of 3 km/s. See: Tom Z. Collina, "The European Phased Adaptive Approach at a Glance," *Arms Control Today,* May 2013, https://www.armscontrol.org/factsheets/Phasedadaptiveapproach. Burnout velocity is the maximum speed acquired by the interceptor. Simply put, the higher the speed of the interceptor, the farther it can go. Burnout velocity can, therefore, serve as a strong indicator of interceptor capability. Before it was canceled, the speculated burnout velocity for SM-3 Block IIB interceptors was between 5 km/s and 5.5 km/s. This report assumes that the value is 5.5 km/s.
[39] The Japanese Kongo class destroyers carry the 90-cell Mk-41 Vertical Launch system (VLS). The Japanese Atago class destroyers carry the 96-cell Mk-41 Vertical Launch system. See: Defense Industry Daily, "Japan's Fleet BMD: Upgrades & UORs," *Defense Industry Daily,* November 10, 2015, http://www.defenseindustrydaily.com/up-to-387m-for-japanese-naval-abm-components-0807/; and "Kongo Class Guided Missile Destroyers, Japan," *Naval Technology*, http://www.naval-technology.com/projects/kongoclassdestroyer/. The VLS contains a mix of the ship's defensive and offensive missile systems. "The VLS consists of vertical cells in the ship's fore and aft deck." In the case of the United States, "cruisers have two blocks on sixty cells each. The [U.S.] destroyers have one block of sixty-four cells and one block of thirty-two cells. Each cell can fire a Standard Missile (SM), a Tomahawk land-attack missile (LACM), or an anti-submarine missile. These VLS launching cells have almost no moving parts and are relatively easy to maintain. The VLS cannot be loaded underway, so reloading must be carried out in port or alongside a properly equipped resupply ship." The actual load-out of a particular ship depends on its designated missions and on missile availability. See: Kenneth W. Allen et al., *Theater Missile Defenses in the Asia-Pacific Region*, 6, 12.
[40] Japanese ships do not possess the ability to simultaneously perform missile defense and air defense. A Japanese missile defense ship will have to be dedicated to that purpose. However, at some point in the future, the Atago class ships will be upgraded to both functions. The author thanks George Lewis for pointing this out.
[41] The National Institute for Defense Studies, *East Asian Strategic Review 2015,* Ch.2, 64.
[42] Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation*, 12, 15.
[43] Ibid.
[44] Ministry of Foreign Affairs of Japan, *Security Consultative Committee Document. U.S.-Japan Alliance: Transformation and Realignment for the Future,* Ministry of Foreign Affairs of Japan, October 29, 2005, http://www.mofa.go.jp/region/n-america/us/security/scc/doc0510.html.
[45] Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation*, 18.
[46] Ibid., 16.
[47] Urayama, *Missile Defense, U.S.-Japan Alliance and Sino-Japanese Relations, 1983-2007*, 245-246.
[48] On the other hand, it is has been argued that Japan is reticent to completely integrate its command and control system with the American system. Such integration might force Japan to intercept missiles that are not heading towards Japan but rather towards the United States or other allies. Intercepting such a missile could be interpreted as a violation of the Japan's constitutional limit on self-defense and be seen as practicing "collective self-defense." See: Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo*, 363. However, in 2003, the Japanese Defense Agency concluded "that the interception of ballistic missiles flying over Japanese air space toward the U.S. does not violate Japan's restrictions on collective security. On the other hand, they concluded that the interception of the ballistic missiles in air space that are not above Japan would violate current restrictions on collective security." See: Col. Tatsuya Arima, *Japanese Security Policy in the Next Ten Years* (Washington DC: The Henry L. Stimson Center, September 2003). In essence, this would indicate that the interception of North Korean or Chinese missiles on a trajectory towards the United States could be justified as long as it occurred over Japanese air space. The United States has continued to ask for commitments from Japan. In 2006, for example, then Commander of the U.S. Naval Forces in Japan, James D. Kelly, argued for the "need for Japan to exercise the right of collective self-defense so bilateral missile defense can work effectively." See: Kyodo News International, "U.S. Commander Sees Need of Japan Using Collective Defense Right," September 7, 2016. Former U.S. Ambassador to Japan Thomas Schieffer has made similar comments. See: David Lawrence, "An Interview With John Thomas Schieffer,

Former U.S. Ambassador to Japan," *The Politic,* August 16, 2013, http://thepolitic.org/an-interview-with-john-thomas-schieffer-former-u-s-ambassador-to-japan/; Urayama, *Missile Defense, U.S.-Japan Alliance and Sino-Japanese Relations, 1983-2007*, 150.

[49] Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation*, 13.

[50] Ibid., 13-14.

[51] Ibid., 14.

[52] Reiji Yoshida and Ayako Mie, "Tokyo Orders SDF To Shoot Down North Korean Missile If Threat To Japan," *The Japan Times,* February 3, 2016, http://www.japantimes.co.jp/news/2016/02/03/national/anger-sanctions-threats-greet-north-korea-rocket-launch-plans/#.VseK0GgrKM8.

[53] Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo*, 176, 180.

[54] For example, Chinese Foreign Ministry Spokesman Zhu Bangzao had said in 1998: "China firmly opposes any direct or indirect activities which attempt to include the Taiwan Straits in the scope of the Japan-US security cooperation relationship…China holds a clear-cut and consistent stand that Japan-US security cooperation is a bilateral arrangement formed with a specific historical background; it should be strictly limited to the scope of bilateral relations between the two countries, otherwise it will upset surrounding countries in Asia and create complexity affecting the security situation in this region." See: Statement by the Government of the People's Republic of China, "Japan-US Security Moves Must Keep Off Taiwan Straits," April 30, 1998, http://fas.org/news/china/1998/980430-prc-japanhtm.htm. Chinese strategists have also stated that "China would be compelled to also hit Japan with missiles in an armed crisis over Taiwan, because 'we (China) know that Japan is by its treaty obligation in the same boat with the United States.'" See: Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo*, 378.

[55] Gregory Kulacki, "The Chinese Military Updates China's Nuclear Strategy," *Union of Concerned Scientists*, March 2015, 5, http://www.ucsusa.org/sites/default/files/attach/2015/03/chinese-nuclear-strategy-full-report.pdf.

[56] "Joint Statement by the Presidents of the People's Republic of China and the Russian Federation on Anti-Missile Defense," July 18, 2000, http://fas.org/spp/starwars/program/news00/bmd-000718a.htm.

[57] Ibid.

[58] U.S. Department of Defense, *Ballistic Missile Defense Review Report* (Washington DC: Department of Defense, 2010), 34.

[59] U.S. Department of Defense, *Nuclear Posture Review Report* (Washington DC: Department of Defense, 2010), 4, 29.

[60] Reuben Steff and Nicholas Khoo, "Hard Balancing in the Age of American Unipolarity: The Russian Response to US Ballistic Missile Defense during the Bush Administration (2001-2008)," *The Journal of Strategic Studies* 37, no. 2 (2014): 233.

[61] Ian E. Rinehart, Steven A, Hildreth, and Susan V. Lawrence, *Ballistic Missile Defense in the Asia-Pacific Region: Cooperation and Opposition* (Washington DC: Congressional Research Service, 2015), 15-18.

[62] Wu Riqiang, "China's Anxiety About U.S. Missile Defence: A Solution," *Survival* 55, no. 5 (October-November 2013): 46.

[63] Japanese security professionals do worry about the Chinese threat. In Japan, the 1995 nuclear testing by China is often portrayed as one of the first China-related "security shocks" to Japan. Apparently, then Japanese Prime Minister Tomiichi Murayama visited China in 1995 and requested China to refrain from further testing. However, Beijing ignored his request and continued its nuclear testing. This incident brought to the fore the lack of leverage Japan had in "influencing Chinese military behavior and had an ironic effect on Japanese domestic politics, in a sense that both the Left and the Right became united in their anti-China sentiments." A second China-related security shock was the 1996 Chinese "decision to actually test its missiles over the Taiwan Straits" which "deeply alarmed many Japanese security professionals, leading them to doubt Beijing's commitment to the so-called 'no-first use' policy." See: Urayama, *Missile Defense, U.S.-Japan Alliance and Sino-Japanese Relations, 1983-2007*, 260-261. A short summary of the more recent Japanese concerns over China can be found in: Sugio Takahashi, *Rebuilding Deterrence: Post-2015 Defense Guidelines Challenges Facing the U.S.-Japan Alliance* (Washington DC: Project 2049 Institute, 2015), http://project2049.net/documents/Takahashi_2015_Defense_Guidelines_Challenges_US_Japan_Alliance.pdf.

[64] Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo*, 320.

[65] Cordesman et al, *The Changing Military Balance in the Koreas and Northeast Asia*, 467-472; Roberts, *On the Strategic Value of Ballistic Missile Defense*, 29-30.

[66] Office of the Secretary of Defense, Department of Defense, *Annual Report to Congress. Military and Security Developments Involving the People's Republic of China 2010* (Washington DC: Department of Defense, 2010), I; Takahashi, *Ballistic Missile Defense in Japan: Deterrence and Military Transformation*, 20.
[67] Office of the Secretary of Defense, Department of Defense, *Annual Report to Congress. Military and Security Developments Involving the People's Republic of China 2010*, 66.
[68] Ibid.
[69] Asmann, *Theater Missile Defense (TMD) in East Asia: Implications for Beijing and Tokyo*, 315.
[70] William J. Perry, "Security and Stability in the Asia-Pacific Region," April 11, 2000, http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan005964.pdf.