Missile Defense and the Strategic Relationship among the United States, Russia, and China

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Dmitry Stefanovich

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Introduction

I am pleased to share this monograph published under the American Academy of Arts and Sciences' project *Promoting Dialogue on Arms Control and Disarmament*. The current nuclear age is characterized by a simultaneous collapse of arms control agreements and the absence of strategic dialogue among the United States, Russia, and China—the three main nuclear players. As we know from the Russia-Ukraine War, today's era is showing worrisome trends for the stability and security of the global nuclear order. As demonstrated during the Cold War, the creation of platforms for innovative brainstorming on areas of common ground is an essential step to reduce tensions, minimize the potential risks of nuclear escalation and arms racing, and promote a more cooperative international environment.

The Promoting Dialogue on Arms Control and Disarmament project brings together nuclear experts to discuss areas of opportunity and policy recommendations. One strand of the project's work consists of a series of Track-2 dialogues among experts and former policy-makers from the United States, Russia, and China that is designed to identify critical short-term goals in arms control. A second strand of work builds on the Academy's prior experience organizing educational sessions on a range of topics for the United States Congress. Through a series of engagements with members of Congress and their staffs, the project fosters knowledge on key issues and challenges facing the United States.

A third strand of work weaves the project's expert discussions and policy recommendations together to produce publications on critical debates within nuclear arms control. This monograph features scholarly contributions from two experts who discuss practical measures to reduce security challenges and mitigate the impact of missile defense on the stability of the relationships among the United States, Russia, and China. In addition to investments in a range of military programs, Washington, Beijing, and Moscow have been developing new missile defense technologies that create new strategic competition, increase the risk of misunderstandings, and heighten threat perceptions.

In "Managing the Impact of Missile Defense on U.S.-China Strategic Stability," **Tong Zhao**, a senior fellow in the Nuclear Policy Program at the Carnegie Endowment for International Peace, discusses the Chinese view on the security dilemma between Washington and Beijing. **Dmitry Stefanovich**, a research fellow at the Primakov Institute of World Economy

and International Relations based in Moscow, covers the Russian view in "The Indispensable Link: Strategic Defensive Capabilities as a Cornerstone of Arms Control and Arms Racing."

Tong's essay explains how the global investment in missile defense has created a security dilemma, especially in the bilateral strategic relationship between the United States and China. He explains the concerns of the Chinese nuclear and policy community. Beijing fears that the United States could acquire capable missile defense technology that would make Chinese responses to nuclear strikes impossible and hence weaken deterrence. On the other hand, policy-makers in the United States are concerned that Chinese nuclear buildup is not a response to U.S. missile defense but rather reflects a desire to expand beyond its traditional minimum nuclear deterrence posture. Tong stresses that a better understanding of each other's thinking is urgently necessary if China and the United States are to address crisis instability. He sees an opportunity for mutual compromise given Chinese concern about U.S. missile defense and the U.S. concern about Chinese antisatellite technologies. Both states could explore a quantitative limit on China's stockpile in exchange for a limit on U.S. deployed strategic capabilities, including its missile defense systems.

In the second essay, Dmitry explains the Russian view on missile defense developments and the strategic stability dialogue with the United States. Russian military strategists are concerned by U.S. space capabilities that enable and enhance Earth-based missile defenses and by the global presence of U.S. missile defense with strike platforms and sensors distributed in several allied countries. Similarly, Moscow has been working to improve its missile defense programs—very much to the concern of the United States. However, Dmitry identifies a few areas for future negotiations, including a Track I discussion, altered language in missile defense reviews, and conversations among experts over technical capabilities.

While both authors highlight that the development of new missile defense technologies adds to the complexity of the U.S. relationship with China and Russia, they also note that there are opportunities for two-way conversations and confidence-building diplomacy. The heightened geopolitical tensions among the three players have underlined the urgency of nuclear arms control work. Amid the war in Ukraine, it is difficult to imagine how arms control between Russia and the United States could be reconstructed. However, arms control was never intended to be a fair-weather policy instrument. Rather, it was the dangers of severe and unrelenting competition and friction between heavily armed superpowers that inspired thinking about the feasibility and desirability of arms control and the kinds of measures that might limit the risks associated with nuclear-armed rivalry. There is an opportunity to shape and impact the

field of nuclear arms control and disarmament at a critical time in history. Most important, Washington, Moscow, and Beijing should explicitly indicate their willingness to consider cooperative measures, and experts should start to seriously explore concrete cooperative measures they each could take.

These lessons about the importance of bilateral discussions, transparency, and unambiguous messages are deeply relevant to the challenges we face today. The authors remind us of the increasing dangers if the United States, Russia, and China do not communicate. The Academy will continue its work to bring together experts from these countries under the Promoting Dialogue project's series of Track 2 meetings and publication series that are designed to highlight critical goals in arms control.

The Academy has played a crucial role in the nuclear field, particularly when a viable path to cooperation and collective governance was not clear. In 1959, at the height of the Cold War and the nuclear standoff between the United States and the USSR, members of the American Academy, including Donald Brennan, Thomas Schelling, and Henry Kissinger, among others, gathered at the Academy to rethink the framework that had governed relations between the two superpowers following World War II and to offer a new model of global interaction. The work of this group, in partnership with contemporaneous policy-makers, helped pave the way for the adoption of a new American nuclear posture based on strategic stability and arms reduction, rather than on arms accumulation. Since then, the American Academy has conducted more than a dozen projects focused on arms control and nuclear policy topics, ranging from the future of submarine-based deterrents to international arrangements for nuclear fuel reprocessing, to weapons in space. Our work continues to shape the dialogue in the nuclear field.

I have no doubt that this publication will serve as an important contribution to contemporary thinking about approaches to arms control and missile defense. The Academy will present and share this publication through a series of outreach activities, and it will be translated into Russian and Chinese for dissemination to policy-makers and the arms control communities in Moscow and Beijing.

I would like to thank Allan Myer, Belinda Frankel, and the Raymond Frankel Foundation for their generous support of the Promoting Dialogue project. I also want to thank Doreen Horschig, Melissa Chan, and Michelle Poulin in the Academy's Global Security and International Affairs program area for their diligent work.

David W. Oxtoby
President, American Academy of Arts and Sciences

Managing the Impact of Missile Defense on U.S.-China Strategic Stability

Tong Zhao

China has long been worried about potential U.S. efforts to use missile defense to undermine China's nuclear deterrent capabilities. Indeed, many American military experts and some officials recognize the role played by American missile defense in incentivizing China's nuclear modernization.[1] China's own investment in developing and potentially deploying various types of missile defense technologies adds to the complexity of the situation but may also open new opportunities for a two-way conversation. The quickly intensifying strategic competition between the two countries significantly increases the risks of misunderstandings and inflated threat perceptions. The proliferation of missile technologies—including hypersonic missile technologies—is also changing American and Chinese calculations about missile defense. These new developments make it necessary to identify key challenges and practical measures to reduce the incidence of security dilemmas and mitigate the impact of missile defense on the stability of the U.S.-China relationship. The following sections offer a few recommendations on key areas where progress may be achievable.

When addressing these issues, this paper makes a special effort to explain Chinese views and why China developed them, as China's positions are not always well understood by the international policy community. The author recognizes that Chinese views are not monolithic. Due to the sensitivity of these issues, however, the paper largely refrains from discussing internal factions in China. While the analysis focuses on the dominant views of the Chinese security policy community, it distinguishes

1. Charles Ferguson, "Sparking a Buildup: U.S. Missile Defense and China's Nuclear Arsenal," *Arms Control Today*, March 2000, https://www.armscontrol.org/act/2000-03/features/sparking-buildup-us-missile-defense-chinas-nuclear-arsenal; and Eric Heginbotham, Michael S. Chase, Jacob Heim, Bonny Lin, Mark R. Cozad, Lyle J. Morris, Christopher P. Twomey, et al., *China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States* (Santa Monica, Calif.: RAND Corporation, 2017), https://doi.org/10.7249/RR1628.

mainstream views from minority views when necessary and explains the general background of domestic stakeholders who embrace certain views.

Clarify Strategic Intention

China has long been concerned that the United States could launch a comprehensive nuclear first strike on China and then use its missile defenses to intercept the surviving Chinese nuclear missiles. In the 1960s, the United States justified its deployment of limited missile defenses against China's emerging nuclear capabilities.[2] The Reagan administration's Strategic Defense Initiative alarmed Beijing about America's missile defense ambitions, although the continuing honeymoon between Washington and Beijing helped mitigate Chinese concerns. Nonetheless, the ending of the Cold War, the continued turmoil in the bilateral relationship, the U.S. withdrawal from the Anti-Ballistic Missile Treaty in 2002, and growing Chinese concerns about the U.S. pursuit of "unilateralism" and "absolute security" have all contributed to greater Chinese anxiety about U.S. missile defenses. Although some Chinese experts understand that current American missile defense capabilities will not seriously threaten the effectiveness of China's nuclear deterrent, the mainstream view within the Chinese nuclear policy community is that, in the future, the United States could acquire a much more capable missile defense. Many Chinese experts genuinely believe that the United States has a long-standing interest in neutralizing China's nuclear deterrent and that the reason Washington has not built such a capability is primarily due to economic and technological constraints.[3]

Public statements by senior American officials on the issue of missile defense have been important in influencing Chinese policy experts' interpretation of U.S. policy objectives. These public statements are not always consistent with formal U.S. government positions. For instance, former President Donald Trump once declared, seemingly off-the-cuff, that the U.S. military seeks "to ensure that we can detect and destroy any missile launched against the United States—anywhere, anytime, anyplace."[4] This

2. Jeffrey Lewis, "China's Orbital Bombardment System Is Big, Bad News—But Not a Breakthrough," *Foreign Policy*, October 18, 2021, https://foreignpolicy.com/2021/10/18/hypersonic-china-missile-nuclear-fobs/.

3. 吴日强 [Wu Riqiang], "中美如何避免核军备竞赛" [How to avoid a China-U.S. nuclear arms race], *当代美国评论* [Contemporary American review] (2) (2017): 39–60.

4. David Vergun, "Trump Pledges to Protect America from Any Enemy Missile," U.S. Department of Defense, January 17, 2019, https://www.defense.gov/News/News-Stories/Article/Article/1734640/trump-pledges-to-protect-america-from-any-enemy-missile/.

statement does not align with the formal U.S. position, which rejects the notion that Washington seeks to use missile defense to undermine China's strategic nuclear deterrent: "The United States relies on nuclear deterrence to address the large and more sophisticated Russian and Chinese intercontinental ballistic missile capabilities."[5] However, statements like the one made by President Trump have had an impact on many Chinese policy experts' understanding of U.S. missile defense policy and are often pointed to as evidence that Washington's missile defense programs seek to undermine the bilateral strategic stability relationship.[6] This raises the need for governments to reduce inconsistencies in official policy declarations.

To address this issue also requires U.S. officials and defense experts to think by standing in China's shoes. If the United States possessed a small arsenal but faced a much stronger enemy interested in developing damage-limitation capabilities through a wide range of conventional, nuclear, and cyber strike technologies, the United States, too, would probably develop a deep level of paranoia based on worst-case-scenario thinking and view the enemy's missile defense development as one more tool to help it achieve nuclear primacy.

China has traditionally emphasized the importance of building trust through a top-down process. Chinese experts stress that the United States should first acknowledge the existence of a mutual vulnerability relationship with China as a strategic reassurance to Beijing that Washington would not seek to undermine China's nuclear deterrent through missile defense or other means.[7] The United States has been reluctant to make an explicit commitment to a mutual vulnerability relationship with China, however—not least due to the concerns of some American allies that this might weaken U.S. extended nuclear deterrence and embolden China to commit military aggression. The Obama administration sought to address its allies' concern by refraining from explicitly referring to mutual vulnerability; at the same time, it promised to maintain a strategic stability relationship with China. This political commitment alone did not

5. U.S. Department of Defense, *2019 Missile Defense Review Report* (Washington, D.C.: Office of the Secretary of Defense, 2019), vii, https://media.defense.gov/2019/Jan/17/2002080666/-1/-1/1/2019-MISSILE-DEFENSE-REVIEW.PDF.

6. 孙涛 [Sun Tao] and 郭彦江 [Guo Yanjiang], "美国下一代反导体系架构解析" [Analysis of U.S. next generation anti-missile system architecture], 军事文摘 [Military digest] (11) (2021): 61–64.

7. Amber Wang, "China's Nuclear Threat Only Keeping Up with US Advances, Chinese Experts Say," *South China Morning Post*, October 19, 2021, https://www.scmp.com/news/china/military/article/3152855/chinas-nuclear-threat-only-keeping-us-advances-chinese-experts.

fundamentally change China's overall suspicion about U.S. missile defense and other developments, but it provided a framework under which the two countries could discuss a wide range of military issues, including missile defense. Such a U.S. political commitment was important to China and remains so today. As the overall bilateral relationship becomes increasingly adversarial, such political reassurance from Washington is even more important in clarifying U.S. strategic intentions in the eyes of Beijing.

That said, China's concern about U.S. missile defense increasingly goes beyond technology per se. China believes the United States has been using missile defense cooperation as a tool to strengthen alliance relationships with its security allies in the Asia Pacific region and to exert U.S. influence in and control of its allies' foreign and security policies.[8] China has long viewed the U.S.-led alliance as its primary security threat in the region and therefore is very displeased about the role missile defense cooperation may be playing in bolstering such alliance relations. Practical measures that either side could take to effectively address this concern are unlikely to emerge in the foreseeable future.

The lack of a clear declaratory policy and detailed explanatory statements about its strategic security policies also make Beijing's intentions ambiguous. Some American experts doubt that China is genuinely worried about U.S. missile defense.[9] They believe China has a clear understanding that the United States has neither the intention nor the capability to threaten China's nuclear deterrent in this way. Unfortunately, this American perception is inaccurate. The concerns of Chinese experts—including policy and technical experts—may be misplaced, but the experts are convinced of their views. This indicates that the Chinese experts need to better explain their specific concerns and that American experts need to look deeper into Chinese views as a starting point for building mutual understanding.

More important, Washington has grown suspicious that Beijing has been modernizing its nuclear arsenal for reasons that have little to do with U.S. missile defense development. For instance, some American experts suspect that China is building up its nuclear capabilities because Beijing wants to bolster its status as an international power and/or to expand the role of its nuclear weapons beyond its traditional minimum deterrence

8. 安雨康 [An Yukang], 论导弹防御对美国亚太军事同盟的影响 [The impact of missile defense on the U.S. military alliances in Asia-Pacific], 国际关系学院 [Institute of International Relations], Beijing, 2018.

9. Matthew R. Costlow, "The Missile Defense 'Arms Race' Myth," *Strategic Studies Quarterly* 15 (1) (2021): 3–9.

posture.[10] China may face growing pressure to explain how its nuclear buildup—such as the sudden construction of hundreds of new missile silos in its Gansu, Xinjiang, and Inner Mongolia regions, probably for the purpose of deploying intercontinental ballistic missiles (ICBMs)—was a proportionate response to the U.S. effort to gradually improve its missile defense capabilities.[11] The silence of China's government and its state media's dismissal of many of these reported developments have further contributed to American suspicions.

In summary, China views U.S. missile defense as posing a greater potential threat to China's nuclear deterrent than other U.S. military capabilities.[12] However, China has not established a clear and convincing linkage between the development of American missile defense capabilities and China's comprehensive nuclear modernization to make the case for Washington to take seriously Chinese concerns about U.S. missile defense.

Demonstrate Interest in Cooperative Measures

For Washington to be willing to put its missile defense program on the negotiating table, Beijing may also need to be prepared to make reciprocal concessions on limiting its own nuclear buildup. To this end, an exchange of ideas about the specific missile defense and nuclear restraints each would like to see from the other would be helpful.

Facing ongoing U.S. conventional, cyber, and nuclear capability development in Asia and the deteriorating bilateral relationship that makes China unwilling to engage in arms control or confidence-building diplomacy, Beijing may feel increasingly motivated to deal with the perceived missile defense challenge through unilateral measures. Decades of fast economic growth have given China the option to substantially expand its nuclear forces at a speed and scale that would offset any potential impact of U.S. missile defense improvements. In addition to the new ICBM silos, China has now publicly endorsed a new policy of developing its own nuclear

10. *2021 Annual Report to Congress of the U.S.-China Economic and Security Review Commission* (Washington, D.C.: U.S. Government Printing Office, 2021), https://www.uscc.gov/sites/default/files/2021-11/2021_Annual_Report_to_Congress.pdf.

11. Matt Korda and Hans Kristensen, "A Closer Look at China's Missile Silo Construction," Federation of American Scientists, November 2, 2021, https://fas.org/blogs/security/2021/11/a-closer-look-at-chinas-missile-silo-construction/.

12. Tong Zhao, *Narrowing the US-China Gap on Missile Defense: How to Forestall a Nuclear Arms Race* (Washington, D.C.: Carnegie Endowment for International Peace, 2020), https://carnegieendowment.org/2020/06/29/narrowing-u.s.-china-gap-on-missile-defense-how-to-help-forestall-nuclear-arms-race-pub-82120.

triad—the delivery of nuclear warheads via sea, land, and air systems—despite the country's traditional criticism of U.S. and Russian nuclear triad capabilities. Comprehensive modernization has been taking place across the board, including silo-based ICBMs, road-mobile ICBMs, nuclear strategic submarines, and nuclear-capable strategic bombers.[13] If Beijing is determined to rely on its own nuclear buildup to address security concerns, that would leave little room for cooperative measures to jointly manage the bilateral nuclear relationship, including the issue of missile defense.

In addition to numerical expansion, China appears hopeful that new technologies, such as boost-glider delivery systems, may help keep China ahead of future missile defense threats. Chinese experts are in general agreement that boost-glider systems could add significantly to China's capacity to penetrate advanced U.S. missile defense systems, although technical experts continue to explore to what extent intercontinental-range boost gliders may be vulnerable to developments in precise tracking and advanced interception technologies.[14] China's evaluation of the penetration capability of boost gliders vis-à-vis expected U.S. missile defense technological advancement will continue to influence Chinese policy deliberation.

Also important is how much China can develop advanced missile boosters and propellant, stealth materials, decoys, and intelligent trajectory maneuvering technologies.[15] In some of these areas, China has become unprecedentedly confident, as Chinese scientists and engineers reportedly have made critical breakthroughs that put China in a leading position ahead of the other major powers.[16] China has also been developing and training for operational tactics to increase the overall penetrability of its missile attack, such as coordinating the launch time, sequence, location,

13. Office of the Secretary of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China, 2021* (Washington, D.C.: Department of Defense, 2021).

14. 樊菁 [Fan Qing], 丛彬彬 [Cong Binbin], 王建 [Wang Jian], 陈豪 [Chen Hao], 万田 [Wan Tian], and 李帅辉 [Li Shuaihui], "洲际滑翔飞行器天基红外探测的信噪比分析" [Signal-to-noise analysis of space-based infrared detection for intercontinental glide vehicles], *中国科学: 物理学 力学 天文学* [Scientia sinica: Physica, mechanica & astronomica] 50 (5) (2020): 126–134.

15. 李乔扬 [Liu Qiaoyang], 陈桂明 [Chen Guiming], and 许令亮 [Xu Lingliang], "弹道导弹突防技术现状及智能化发展趋势" [Current status and intelligent development trend of ballistic missile surge defense technology], *飞航导弹* [Aerodynamic missile] (7) (2020): 56–61.

16. Stephen Chen, "Chinese Team Claims 'Highly Reliable' Communications During Hypersonic Flight," *South China Morning Post*, August 30, 2022, https://www.scmp.com/news/china/science/article/3190695/chinese-team-claims-highly-reliable-communications-during.

and attack directions of groups of missiles, including using artificial intelligence to achieve "intelligent coordination."[17] China is constructing "system penetration" capabilities by developing a wide range of technologies—including anti-satellite (ASAT) technologies—to systematically interfere with all components of the U.S. missile defense network.[18] Because China believes a comprehensive military competition with the United States is unavoidable and that it therefore has to modernize its military capabilities across the board, if Beijing also thinks it will be able to achieve "system penetration" capabilities, then it will feel less pressure to consider cooperative measures to address the missile defense problem.

Even more important, China appears increasingly determined to develop and deploy advanced missile defense technologies. This could further reduce Chinese interest in an international agreement to limit missile defense development or deployment.

An important driver behind China's growing interest in developing its own missile defense is the perception that the other major powers and many of their security allies are making heavy investments in advanced missile capabilities. This leads Chinese experts to argue that such developments are part of an important international trend—namely, that major military actors will increasingly rely on missiles in their defense strategies—and that China must be able to deal with this threat. The trend is particularly obvious in the Asia-Pacific region, with U.S. security allies such as Japan and South Korea pursuing various missile technologies. The termination of the Intermediate-Range Nuclear Forces (INF) Treaty allows the United States to quickly develop theater-range missile technologies as well. Many Chinese experts argue that U.S. determination to build up such missile capabilities against China led to Washington's withdrawal from the INF Treaty in the first place, a view that reinforces the perception that the international trend of missile development enjoys strong forward

17. 温广辉 [Wen Guanghui], 周佳玲 [Zhou Jialing], 吕跃祖 [Lu Yuzu], 刘照辉 [Liu Zhaohui], and 吕金虎 [Lu Jinhu], "多导弹协同作战中的分布式协调控制问题" [Distributed coordination control in multi-missile cooperative operations], *指挥与控制学报* [Journal of command and control] 7 (2) (2021): 137–145.

18. 梁蕾 [Liang Lei], "洲际弹道导弹突防技术发展趋势" [Trends of ICBM penetration technologies development], *飞航导弹* [Aerodynamic missile] (8) (2018): 55–57, 63; 汪民乐 [Wang Minle], "弹道导弹突防对策综述" [Overview of ballistic missile penetration countermeasures], *飞航导弹* [Aerodynamic missile] (10) (2012): 45–51; and 罗曦 [Luo Xi], "美国导弹防御助推段拦截技术及其战略影响" [U.S. missile defense boost-phase intercept technologies and strategic implications], *中国国际战略评论2019(上)* [China international strategic review] 1 (2019): 204–221.

momentum and thus China would be amiss not to develop its own advanced counter-capability.[19]

The introduction of hypersonic technologies—including boost gliders and hypersonic cruise missiles—adds to China's incentive to develop missile defenses. Hypersonic missiles are not a completely new type of weaponry. Existing missiles have demonstrated such capabilities as high speed, maneuverability, and high accuracy, although hypersonic missiles expand some of these capabilities beyond existing levels. But hypersonic missiles have generated new threat perceptions. They are generally believed to be faster and better capable of defeating missile defenses than traditional ballistic missiles and thus may pose a greater threat to critical military targets such as mobile command, control, and communication centers. In most cases, they carry conventional warheads or even use kinetic energy to destroy the target, which may make them more militarily usable on the battlefield. That such weapons may be relatively expensive and hard to procure and deploy in large numbers increases major powers' confidence and interest in seeking an affordable capability to defend against them. For all these reasons, Chinese experts argue that it is increasingly important for a major power to acquire an integrated anti-air, anti-missile, anti-near space, and anti-space capability that can address threats from all related domains.[20]

Chinese experts also believe that, from a technical perspective, the development of missile technologies and missile defense technologies are increasingly intertwined and mutually beneficial.[21] They argue that the emerging threat from a variety of new conventional missile systems, including hypersonic missiles that are being developed and deployed by the United States, Japan, and other countries, means China faces a practical need to develop defensive capabilities in addition to continuing to develop

19. 邹治波 [Zou Zhibo], "美国退出《 中导条约》 的当代含意与影响" [Implications and impacts of U.S. withdrawal from Intermediate-Range Nuclear Forces Treaty], *国际经济评论* [International economic review] 1 (2020): 31–42.

20. 陈翔 [Chen Xiang], 董立勇 [Dong Liyong], and 于宁宇 [Yu Ningyu], "美军导弹防御拦截武器发展趋势分析" [Analysis of the development trend of U.S. military missile defense interceptor weapons], *军事文摘* [Miliary digest] (23) (2020): 44–47.

21. 刘野 [Liu Ye], 袁欣 [Yuan Xin], and 张蕾 [Zhang Lei], "美国多方位防御-快速拦截弹交战系统发展情况分析" [Analysis of the development of the U.S. multi-directional defense-rapid interceptor engagement system], *飞航导弹* [Aerodynamic missile] (3) (2020): 1–4.

more advanced offensive weapons.[22] In some cases, Chinese thinking seems to have been influenced by misunderstandings about U.S. capabilities and policies. For instance, Chinese experts observe that the United States is adopting a new policy to arm ICBMs with conventional warheads as part of a plan to build up its prompt global strike capabilities.[23] This observation appears to result from an inaccurate reading of the previous American Conventional Prompt Global Strike plans. During the Obama administration, some American military officials considered the option of conventional ICBMs.[24] But U.S. leaders chose not to pursue this option because they were concerned that the ambiguity of ICBMs capable of carrying either conventional or nuclear warheads would create incentives for the country being attacked to assume the worst and respond with nuclear strikes even if the U.S. missiles were carrying conventional warheads. Nonetheless, some Chinese experts seem to either believe these programs are still ongoing or think the U.S. government has started some new programs to develop similar capabilities. The Chinese misreading of this U.S. policy could make China more determined to develop long-range missile defense capabilities in addition to investing more in its own long-range

22. 王永海 [Wang Yonghai], 张耀 [Zhang Yao], 李漫红 [Li Manhong], 路瑞敏 [Lu Ruimin], and 王立研 [Wang Liyan], "日本高超声速导弹发展计划分析与研究" [Analysis and study of Japan's hypersonic missile development program], *飞航导弹* [Aerodynamic missile] (11) (2019): 39–42; 陈星宇 [Chen Xingyu], "(美国高超声速导弹武器研制进展及思考" [Progress of U.S. hypersonic missile weapons development and reflections], *中国航天* [Aerospace China] (5) (2021): 62–66; 闫孟达 [Yan Mengda], 杨任农 [Yang Rennong], 张滢 [Zhang Ying], 胡东愿 [Hu Dongyuan], 张泽 [Zhang Ze], 岳龙飞 [Yue Longfei], and 马铭希 [Ma Mingxi], "美国中段反导预警探测系统作战流程分析" [Analysis of the operational process of the U.S. mid-course anti-missile early warning detection system], in *第九届中国指挥控制大会论文集* [Proceedings of the Ninth China Command and Control Conference] (July 5, 2021); and 汤志成 [Tang Zhicheng], "假如美在亚太部署陆基中程导弹" [If the U.S. deploys land-based intermediate-range missiles in the Asia-Pacific], *兵器知识* [Ordnance knowledge] (10) (2019): 1.

23. 代勋勋 [Dai Xunxun], "新核政策能否助俄化解军控压力" [Can new nuclear policy help Russia defuse arms control pressure], *世界知识* [World affairs] (13) (2020): 46–47. Prompt global strike is a U.S. military effort, especially during the George W. Bush and Barack Obama administrations, to develop capabilities that could deliver a precision conventional weapon to most parts of the world within a very short period of time, such as an hour. There was once a military proposal of modifying ICBMs to deliver conventional warheads but the proposal did not materialize into an actual program.

24. Amy F. Woolf, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, Congressional Research Service R41464 (Washington, D.C.: Congressional Research Service, January 8, 2019; updated July 16, 2021), https://sgp.fas.org/crs/nuke/R41464.pdf.

strike technologies. Bilateral expert exchanges and dialogues may help to clarify such misunderstandings and prompt China to reflect on its perceived need to develop certain missile defense technologies.

China believes the United States, Russia, and other major powers have all been accelerating their investment in missile defense capabilities and that it must "borrow their experiences" and learn from their thinking.[25] As China's overall economic growth outpaced that of other major powers and as Beijing significantly narrowed the economic gap with Washington in recent decades, Chinese strategists increasingly argue that China should develop capabilities that are commensurate with its great-power status.[26] The development of advanced missile defense capabilities is viewed in a similar vein.[27] Chinese experts also believe that China's overall economic strength will eventually lead to China's successful acquisition of advanced missile defense capabilities. They think China's increasingly close security cooperation with Russia provides another advantage in China's pursuit of such capabilities, including through Chinese-Russian joint development and even joint deployment of certain missile defense technologies.[28] By proactively exploiting new technologies and innovative tactics, China expects to "transition from passively catching up (with the frontrunners)

25. 郭衍莹 [Guo Yanying], "俄战略反导系统亮点何在" [What are the highlights of the Russian strategic anti-missile system], *中国国防报* [National defense news], May 25, 2020, 4; 唐永胜 [Tang Yongsheng], "国际安全与军控形势：博弈激烈，治理缺失" [International security and arms control situation: Intense gaming, lack of governance], *世界知识* [World affairs] (24) (2020): 42–44; and 邹伟 [Zou Wei], 赵国艳 [Zhao Guoyan], and 韩仲瑶 [Han Zhongyao], "探索天基反导武器在未来作战中的应用" [Exploring the application of space-based anti-missile weapons in future operations], in *2020中国航空工业技术装备工程协会年会论文集* [2020 China Aviation Industry Technical Equipment Engineering Association annual meeting proceedings] (2020), China Aviation Industry Technical Equipment Engineering Association, Xi'an, 488–491.

26. In recent years, China's economic development has slowed, but China's officially declared economic growth rates are still slightly higher than the United States' economic growth rates.

27. 陈翔 [Chen Xiang], 董立勇 [Dong Liyong], and 于宁宇 [Yu Ningyu], "美军导弹防御拦截武器发展趋势分析" [Analysis of the development trend of U.S. military missile defense interceptor weapons].

28. 柳丰华 [Liu Fenghua], "俄美中导竞争与中国应对方略" [Russia-U.S. INF competition and China's response strategy], *北方论丛* [Northern literary studies] (4) (2021): 26–34, 166.

toward an active leapfrog development mode" that would make it a leader in missile defense capabilities.[29]

Chinese experts have conducted extensive technical studies on various types of missile defense technologies and operational strategies.[30] The mainstream view appears to be that China should conduct comprehensive research and development on all types of missile defense technologies—including technologies to defend against hypersonic missiles—and focus on the deployment of multilayered but limited missile defense capabilities over key areas in the near term. Examples of key areas to be protected likely include the capital city and important military facilities such as command and control centers and strategic missile fields. One of the reasons for China's reported construction of relatively densely populated silo-based ICBM sites may be to make missile defense protection easier, since the alternative would involve the construction of large-area missile defense capabilities to protect road-mobile strategic missiles that are usually scattered across much larger areas.

China seems to be taking an incremental, wait-and-see approach to its long-term deployment plans, keeping options open and not rushing into any specific plan until it has a better idea of how its overall security environment will evolve and what technologies will become available. This appears to be a relatively pragmatic approach, especially when compared with China's apparent decision to build up its nuclear forces quickly and substantially. China's missile defense decisions will also be influenced by whether the United States and its allies deploy medium- and longer-range missiles—and how many—in the Asia-Pacific region, as well as whether China's economy continues to perform well enough to provide funding for major new defense projects. But the wish to keep options open, including deployment options, is likely to make China hesitant to engage in serious negotiations that may limit its future missile defense capabilities. That said, American willingness to accept reciprocal constraints on its own missile defenses could help incentivize China to do the same.

29. 陈翔 [Chen Xiang], 董立勇 [Dong Liyong], and 于宁宇 [Yu Ningyu], "美军导弹防御拦截武器发展趋势分析" [Analysis of the development trend of U.S. military missile defense interceptor weapons].

30. 曹莉 [Cao Li], 周亮 [Zhou Liang], 耿斌斌 [Geng Binbin], 吴昕芸 [Wu Xinyun], and 赵钱 [Zhao Qian], "空基助推段反导拦截能力需求与仿真分析" [Requirement and simulation analysis of air-based booster segment anti-missile interception capability] *空天防御* [Air and space defense] 3 (1) (2020): 87–92; and 邹伟 [Zou Wei], 赵国艳 [Zhao Guoyan], and 韩仲瑶 [Han Zhongyao], "探索天基反导武器在未来作战中的应用" [Exploring the application of space-based anti-missile weapons in future operations].

These Chinese considerations do not mean China will not talk with the United States. To facilitate such bilateral discussions, however, a better understanding of Chinese thinking would help international analysts propose more practical cooperative measures that are appealing to China and more likely to yield results. The history of the bilateral nuclear relationship suggests that the long-standing U.S. reluctance to put missile defense on the negotiating table contributed to China's growing interest in unilateral measures to address its concerns about American missile defenses. China has already embarked on a path to significantly enhance its nuclear capabilities and develop various counter-capabilities—some of which, such as ASAT, will create long-term challenges to the overall security relationship.

Fortunately, no evidence indicates that China has officially and completely closed the door for exploring cooperative measures to tackle the missile defense challenge; rather, it appears to remain ambivalent about whether it will do so. To build guardrails and reduce the risk of the bilateral security relationship spiraling out of control, both Washington and Beijing should more explicitly indicate their willingness to consider cooperative measures, and experts from both countries should start to seriously explore concrete cooperative measures they each could take. The following sections examine specific areas in which progress might be made.

Manage the Connection between Strategic and Regional Missile Defenses

At the end of the day, the principal positions of the United States and China on missile defense are not in conflict. The official U.S. policy remains that it relies on its offensive nuclear capabilities to deter Chinese nuclear attack and that American strategic missile defenses are not aimed at undermining the Chinese nuclear deterrent but rather are focused on protecting the U.S. homeland from North Korean and (future) Iranian threats. American regional missile defenses, on the other hand, do not distinguish which country the threat comes from and aim to counter all possible threats. In theory, the inclusive nature of the targets of American regional missile defense could pose a threat to China's capacity to conduct limited nuclear retaliation against regional targets and thus could undermine China's nuclear deterrent at the regional level.[31] But Chinese officials have not specifically identified such a threat. Rather, concerns have focused primarily on the impact of American strategic missile defenses on China's strategic nuclear deterrent against the United States. Beijing appears to implicitly accept

31. For a more detailed discussion, see, for example, Zhao, *Narrowing the US-China Gap*, 18–24.

the U.S. thinking that regional missile defenses are not a strategic concern to China if they do not threaten China's nuclear second-strike capability against the American homeland. Therefore, addressing the Chinese concern about American strategic missile defenses should remain the priority of bilateral discussions.

So far, the United States possesses only one type of dedicated strategic missile defense system: the Ground-based Midcourse Defense (GMD), which is based on ground-based interceptors (GBI). The U.S. buildup of its GMD system has been relatively slow. After decades of work, only forty-four GBIs have been deployed. The next planned step is to add twenty more in a few years.[32] The employment doctrine seems to envision using more than one GBI against one incoming target.[33] This significantly limits the threat the GMD system currently poses to Chinese nuclear forces, which reportedly comprise more than one hundred ICBM launchers and around seventy-two SLBM launchers at the time of this research.[34] One important uncertainty for China is whether the United States will be able to substantially increase the efficiency of the GMD system; for example, by successfully developing and deploying the technology to take out multiple objects with one interceptor vehicle.[35] However, the GMD's development track record suggests that sudden perfection and operationalization of such advanced technologies are unlikely. Continued transparency on the qualitative and quantitative improvement of the GMD program should help mitigate exaggerated Chinese threat perceptions of the program's potential impact on China's nuclear deterrent.

Space-based interceptors and directed energy weapons are examples of other technologies that may contribute directly to the U.S. strategic missile defense. But these technologies are also unlikely to become fully operational in a short period of time, even if they receive sustained investment

32. Matt Korda and Hans M. Kristensen, "US Ballistic Missile Defenses, 2019," *Bulletin of the Atomic Scientists* 75 (6) (2019): 295–306.

33. George Lewis, "Ballistic Missile Defense: How Many GMD System Interceptors Per Target?" *mostlymissiledefense*, May 23, 2012, https://mostlymissiledefense.com/2012/05/23/ballistic-missile-defense-how-many-gmd-system-interceptors-per-target-may-23-2012/.

34. Hans M. Kristensen and Matt Korda, "Nuclear Notebook: Chinese Nuclear Forces, 2021," *Bulletin of the Atomic Scientists*, November 15, 2021, https://thebulletin.org/premium/2021-11/nuclear-notebook-chinese-nuclear-forces-2021/.

35. Jen Judson, "Pentagon Hits Pause on Redesign of Critical Homeland Missile Defense Component," *DefenseNews*, May 28, 2019, https://www.defensenews.com/pentagon/2019/05/28/pentagon-hits-pause-on-redesign-of-critical-homeland-missile-defense-component/.

in the future. Therefore, China should have sufficient time to react if and when such technologies become a realistic threat to its nuclear deterrent.

So far, nothing indicates that Washington plans to expand the target of its strategic missile defenses from focusing on rogue states to also including China and/or Russia. Under existing U.S. policy, the key variable in Washington's calculus on whether to dramatically scale up its strategic missile defenses is whether North Korea will massively build up its intercontinental-range nuclear forces. However, if China were to demonstrate serious interest in developing conventional intercontinental-range missiles capable of targeting the U.S. homeland, this could lead to important changes in Washington's strategic missile defense deployment policy, making it much harder, if not impossible, for the two sides to seek cooperative measures to mitigate the impact of U.S. strategic missile defenses on bilateral nuclear stability.

One important uncertainty rests with the Chinese development of hypersonic missiles (boost gliders and hypersonic cruise missiles) and the U.S. development of defensive capabilities against such weapons. As China's development of hypersonic technologies appears to be driven to a considerable extent by the desire to penetrate missile defense systems, China may see nuclear-capable hypersonic missiles as important for enhancing its nuclear deterrent in the long run. Beijing sees conventionally armed hypersonic missiles as useful, too, so China might eventually want to acquire hypersonic missiles—including those of intercontinental range—for both nuclear and conventional purposes. Washington has never imposed an explicit limit on its own development and deployment of defensive capabilities against hypersonic missiles (in contrast to traditional ballistic missiles), nor has it acknowledged such defensive capabilities' potential impact on the issue of nuclear deterrence in major power relations. But the United States may have little incentive to limit hypersonic defenses if China imposes no limit on its development of conventional hypersonic missiles. China's apparent interest in investing in its own hypersonic defenses complicates the equation further.

Clearly, the need is growing for the two sides to start exchanging views about how they understand the impact of hypersonic missiles and hypersonic defenses on their nuclear relationship. Currently, U.S. hypersonic defense strategy includes serious work on mid-course interception, which requires the development of interceptors that work at much lower altitude than traditional long-range mid-course anti-ballistic missile interceptors. Technical differences like this make it necessary for the two countries to have an exchange on the impact of hypersonic defense, in addition to bilateral discussions on ballistic missile defense. Even if they cannot make progress on the latter, they can still seek to begin a separate, open-ended

dialogue on the former. And since hypersonic defense is still at a relatively early stage of development in both countries, exploration of a joint framework to understand and even regulate future policies for hypersonic defense should face fewer entrenched bureaucratic interests.

As for missile defense in general, one major challenge for the foreseeable future is posed by Washington's growing interest in expanding the capabilities of missile defense systems originally designed for regional purposes to contribute to U.S. strategic defense. The Aegis regional defense system (especially the SM-3 Block IIA interceptor; hereinafter shortened to "SM-3 IIA") causes the greatest concern. SM-3 IIA interceptors may have some capacity to engage intercontinental-range targets and thus be used as an underlayer for existing U.S. strategic missile defenses. The United States also could procure and deploy the less costly SM-3 IIA interceptors in much larger numbers than the GBI and thus quickly expand its overall arsenal of strategic interceptors.[36] The U.S. military also envisions having the Terminal High Altitude Area Defense (THAAD) system play a supplementary role in strategic missile defense. However, the THAAD system can intercept ICBMs only during their terminal phase, making its potential defended area much smaller than that of an SM-3 system. Therefore, Washington should first explore the possibility of addressing Chinese concerns about the SM-3 system, which increasingly drive China's threat perception. A successful test of the SM-3 IIA interceptor against an ICBM-class target in November 2020 and continuing efforts to improve the interceptor's capability in this area add to the urgency.

The lack of exchanges among technical experts from the two countries means that China is more likely to have overestimated the threat of the SM-3 IIA interceptors to its nuclear deterrent. For example, SM-3 IIA has been portrayed in official U.S. materials and expert studies as having the kinematic capacity to intercept an ICBM-class target during both the ICBM's ascent and descent phases.[37] This may be true for some ICBM-class missiles under certain conditions, but calculations that apply specifically to the scenario of a Chinese ICBM attack on the U.S. homeland reveal that SM-3 IIA interceptors (assuming a burnout velocity of 4.5 kilometers per second) do not have the kinematic capacity to engage ICBMs launched

36. George Lewis, "Strategic Capabilities of SM-3 Block IIA Interceptors," *mostlymissiledefense*, June 30, 2016, https://mostlymissiledefense.com/2016/06/30/strategic-capabilities-of-sm-3-block-iia-interceptors-june-30-2016/.

37. National Research Council, *Making Sense of Ballistic Missile Defense: An Assessment of Concepts and Systems for U.S. Boost-Phase Missile Defense in Comparison to Other Alternatives* (Washington, D.C.: National Academies Press, 2012), 27, https://doi.org/10.17226/13189.

from known Chinese ICBM sites toward the U.S. homeland during the ascent phase, even if the SM-3 IIA interceptors are deployed off the Chinese coast.[38] Rather, the kinematic capacity of SM-3 IIA interceptors is such that they could potentially engage Chinese ICBMs only during the descent phase of the ICBM flight and only if the interceptors are deployed near the U.S. West or East Coast. The United States would thus need to deploy Aegis Ashore systems and/or deploy shipborne Aegis systems off its coasts. To build sufficient Aegis Ashore systems might not be a small investment, and to deploy enough Aegis ships off its coasts would considerably constrain the U.S. capability to use its already stretched Aegis fleet to carry out other key military operations. That is, the actual U.S. capacity to use SM-3 IIAs to intercept Chinese ICBMs is quite limited. Furthermore, U.S. construction of Aegis Ashore sites on its coasts and deployment of Aegis ships to U.S. coastal regions cannot be hidden from China, which provides Beijing with an opportunity to develop good situational awareness and prepare countermeasures.

Chinese technical experts either have not conducted in-depth analysis of the actual capability of SM-3 IIA interceptors against Chinese ICBMs, or they have drawn conclusions different from the above analysis, as they continue to argue that SM-3 IIA interceptors pose a serious threat because they can be forward-deployed in the Asia-Pacific region and intercept ICBMs at an earlier stage than the U.S. GMD system.[39] Such technical assessments then shape the views of Chinese policy experts, thus influencing China's overall threat perception. For this reason, technical experts from the two countries should seek to use publicly available information to conduct a joint assessment of the realistic coverage area of SM-3 IIA interceptors under various deployment scenarios. This may help build common views on the severity of the impact of such interceptors.

Other factors could further limit the SM-3 IIA's ability to intercept Chinese ICBMs. For instance, calculations of the SM-3 IIA's kinematic coverage usually assume that the U.S. radar network can provide full, accurate, and timely tracking and cuing information for all Chinese ICBM flight trajectories. However, Washington may need considerable time and effort to acquire such a capability. The current long-range radars may also be vulnerable to kinetic and nonkinetic attacks. Furthermore, the United States uses the descriptor "ICBM-class target" to refer to any ballistic missile with a

38. Computer modeling conducted by Jaganath Sankaran, assistant professor at the Lyndon B. Johnson School of Public Affairs at the University of Texas, Austin.

39. 熊瑛 [Xiong Ying], "标准 3 Block 2A首次洲际弹道导弹拦截试验分析" [Standard 3 Block 2A first ICBM intercept test analysis], *飞航导弹* [Aerodynamic missile] (2) (2021): 53–58.

range of at least 5,500 kilometers. But a Chinese ICBM capable of targeting the U.S. homeland needs to have a range of at least 8,000 kilometers and ideally more than 11,000 kilometers. Depending on what ICBM target was used in the November 2020 test, the SM-3 IIA may not yet have a proven capability against most Chinese ICBMs. The likelihood that the 2020 test was conducted under idealized and "highly favorable" conditions also means that predictions of the SM-3 IIA's performance against real-world targets—especially against ICBMs equipped with decoys and other countermeasures—are less reliable.[40]

The lack of Chinese analysis of these constraining factors makes China more likely to overestimate U.S. capabilities. Certain interests inside the Beltway may also be keen to use China's concern about U.S. development and deployment of such systems to advance U.S. foreign policy goals. When Washington was considering THAAD deployment to South Korea, some senior American officials sought to use Chinese anxiety about THAAD to pressure Beijing to impose more sanctions on North Korea to contain Pyongyang's nuclear program.[41] Any U.S. interest in exploiting Chinese concern about SM-3 IIA, however, would work against the U.S. interest in mitigating China's overestimation of threats. Therefore, the United States needs to comprehensively evaluate how China's threat perception of U.S. missile defense may affect U.S. interests and then send unambiguous and consistent messages to China.

Chinese experts have extensively discussed how seriously the U.S. SM-3 IIA could threaten China's deterrent capabilities. Far less discussion has occurred about how China wants the perceived threat to be contained, especially what China might want the United States to do to sufficiently reduce the perceived threat. Beijing's interests would be served by making specific requests and/or proposing specific measures it would like Washington to take regarding the development and/or deployment of SM-3 IIA. Even if Washington did not immediately accept the Chinese proposals, they could still serve as a useful starting point for substantive engagement at either the expert or official level.

40. U.S. Government Accountability Office, *Missile Defense: Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, GAO-21-314 (Washington, D.C.: U.S. Government Accountability Office, April 2021), https://www.gao.gov/assets/gao-21-314.pdf.

41. David E. Sanger and Michael R. Gordon, "U.S. May Soon Increase Pressure on China to Constrain North Korea," *The New York Times*, March 15, 2017, https://www.nytimes.com/2017/03/15/us/politics/united-states-china-north-korea-nuclear-missiles.html.

Rising tensions over the Taiwan Strait in recent years make such efforts all the more important. Regional missiles and regional missile defense systems would play a significant role in any war across the Taiwan Strait. The measures discussed in this section could help efforts to delink the intensified competition between missile and missile defense capabilities at the regional level from the broader U.S.-China strategic nuclear relationship.

Address the Overlap of Missile Defense and Anti-Satellite Technologies

U.S. reliance on space-based assets to execute missile defense operations has incentivized China to develop various ASAT technologies. China's growing ASAT capabilities have caused concern in the United States and led Washington to pressure Beijing to constrain its ASAT program. The Chinese concern about U.S. missile defense and the U.S. concern about Chinese ASAT intentions may create space for mutual compromise. More important, the inherent overlap between missile defense and ASAT technologies means that any agreement to impose limits on one technology would inevitably have implications for the other. For instance, U.S. efforts to reach a bilateral or multilateral agreement to constrain the development of certain ASAT technologies may also undermine U.S. capacity to test and develop certain missile defense capabilities. Similarly, Chinese interest in limiting U.S. missile defense development may also make it harder for Beijing to continue its testing and development of certain ASAT capabilities. However, neither country has stated whether or how it is prepared to deal with the consequences to its own capability development even as it expresses concern about the other's respective capabilities. Consideration of an integrated framework is therefore necessary. China's growing interest in developing its own missile defense technologies and the continued interest in certain ASAT capabilities within some quarters of the American defense community could increase the need to consider elements of missile defense and ASAT together.

China's investment in ASAT technologies is motivated by more than one military objective, but countering U.S. missile defense has remained a key driving force.[42] The two sides could thus profitably explore a joint

42. 白新有 [Bai Xinyou], 王枭 [Wang Xiao]), and 楚樊星 [Chu Fanxing], "掩护弹道导弹突防支援干扰措施研究" [Research on support jamming measures for covering ballistic missile penetration], *战术导弹技术* [Tactical missile technology] (3) (2021): 126–132; 程强 [Cheng Qiang] and 游敬云 [You Jingyun], "对弹道导弹防御系统的电子对抗技术分析" [Analysis of electronic countermeasures against ballistic missile defense system], *舰船电子对抗* [Ship electronic countermeasure] 50 (2) (2017): 6–9; and 梁蕾 [Liang Lei], "洲际弹道导弹突防技术发展历程" [History of ICBM penetration technologies development], *飞航导弹* [Aerodynamic missile] (1) (2018): 33–37.

agreement to limit missile defense and ASAT capabilities. However, China's interest in keeping open the option to develop its own missile defense technologies could stand in the way.

China's interest in missile defense might be motivated by ambitions quite different from the U.S. ambition to protect its entire homeland from missile attack. China might instead be interested only in acquiring point missile defense capabilities to protect a limited number of strategic targets, such as key command and control centers, nuclear missile sites, and its political leadership. This would make sense for China, as the financial cost and technological challenges of building a strategic missile defense capable of dealing with the thousands of nuclear weapons in the U.S. arsenal would likely be immense. However, Chinese strategists are not interested in restricting themselves to thinking only about limited deployment of missile defenses; they want to keep all options open for the future. They want to continue developing strategic missile defense technologies for various reasons, including to help inform China's development of missile defense countermeasures. Self-confidence is growing among Chinese strategists, who see China on a steady trajectory that will make it a peer of the United States and eventually surpass it. As a result, they seem to reject the notion that certain capabilities are available only to the United States and beyond the reach of China.

China needs to understand that the rejection of any limits on its own development and deployment of missile defense capabilities would undermine its ability to demand that the United States limit its missile defenses. It would be in China's interest to clarify its vision for its future missile defense capabilities and to seek common areas for reciprocal restraint with the United States, keeping in mind that one side's thinking and objectives significantly shape those of the other. On the other hand, if China sees its goal of missile defense development and deployment to be limited in the long run, or if it at least wants to prioritize the development of protection of key sites for the foreseeable future, that could open up an opportunity to negotiate joint limits with the United States on certain types of strategic missile defense technology development, such as long-range ballistic missile mid-course hit-to-kill interceptors, which would be technologically challenging to employ against a peer competitor under realistic battlefield conditions but, according to worst-case-scenario analysis, could be very threatening to major power strategic stability. In addition, these technologies can be easily adapted to serve as the most worrisome type of direct-ascent ASAT weapon. Any U.S. reassurance that it would not develop conventional long-range missiles, especially those of intercontinental range, could further enhance Chinese interests in such a restraint on strategic missile defense.

If a joint limit on the qualitative development of certain missile defense technologies is too challenging, the two sides could still explore quantitative limits or transparency on deployed strategic capabilities. Given the highly asymmetric capabilities of the two sides' nuclear arsenals and deployed missile defense systems, the two sides might consider a framework in which Washington limits the number of certain types of its deployed missile defense systems in return for Beijing declaring a limit on its nuclear stockpile. As a first step in this direction, the two sides could consider an agreement on reciprocal transparency in which Washington would brief Beijing on U.S. missile defense procurement plans for a given period of time in return for Beijing briefing Washington on its nuclear systems procurement plans during the same period.[43] This confidence-building measure could at least help reduce the risk from worst-case guessing about each other's future capabilities.

China and the United States should also be able to find room for jointly limiting the development or deployment of some of the most dangerous and destabilizing ASAT technologies. China has displayed little interest in this area over the past decades, but the renewed interest in some quarters of U.S. policy circles in developing American ASAT capabilities might pressure Beijing to review its cost-benefit calculation.

ASAT technologies that threaten the enemy's space-based nuclear command, control, and communication (NC3) systems could be particularly destabilizing. China may be interested in attacking such U.S. assets in a crisis because doing so might also undermine U.S. missile defense capabilities, including regional capabilities in East Asia. Because those capabilities are part of the U.S. NC3 system, however, the United States might misunderstand the Chinese objective in developing the requisite ASAT technologies, leading to inadvertent escalation. Many of the U.S. early warning satellites are deployed in geostationary orbit (GEO) and highly elliptical orbits (HEO). Thus, Chinese ASAT technologies that target assets in GEO and HEO could be particularly provocative. The U.S. employment of similar ASAT technologies could be equally problematic to China once China perfects its own space-based early warning capabilities. Some American experts have made detailed proposals to ban the testing or deployment of ASAT technologies that directly threaten satellites in GEO and HEO, including ground-based direct-ascent ASAT, upward-facing ground-based

43. In 2013, the U.S. government proposed a similar missile defense transparency agreement with Russia. See, for example, Steven Pifer, "The Future of U.S.-Russian Arms Control," Brookings Institution, February 26, 2016, https://www.brookings.edu/research/the-future-of-u-s-russian-arms-control/.

lasers, and proximity operations in GEO and HEO.[44] Such proposals are worth serious consideration, especially as part of a reciprocal pact of mutual concessions.

In addition, the U.S. Missile Defense Agency is developing the Hypersonic and Ballistic Tracking Space Sensor system in low earth orbit (LEO) to detect and track ballistic and hypersonic missiles. Some other satellites in LEO, such as earth observation satellites and radar satellites, also play a role in detecting and tracking nuclear missile platforms before missiles are launched. Worried that their nuclear deterrent could be undermined by satellites in LEO, Russia and China may have an interest in holding them under threat.[45]

One type of U.S. missile defense system that could have direct implications for China's interest in ASAT capabilities is space-based missile defense interceptors in LEO. Development of such technology could motivate China to pursue ASAT capabilities more aggressively to protect its nuclear deterrent. Although the Trump administration's *2019 Missile Defense Review Report* expresses interest in better understanding the feasibility of space-based interceptors, the U.S. government does not appear to have made a formal decision to pursue such a capability. For the foreseeable future, this capability is likely to remain so controversial—not least because of its technical complexity and tremendous cost in addition to its vulnerability—that the odds of Washington deciding to acquire it are relatively low.

Nevertheless, the Chinese understanding of U.S. thinking may be different. For example, some Chinese military experts believe the United States is already in the process of deploying space-based interceptors.[46] Experts from the China Aerospace Science and Technology Corporation—one of the two main conglomerates in China's rocket and missile industry—claim that the Starlink satellites' collision-avoidance capability could be easily adapted to intercept ballistic missiles. They also claim—citing a study by a team of senior Chinese rocket engineers—that, in computer simulations, Starlink satellites successfully intercepted more than 350

44. See, for example, James M. Acton, Thomas Macdonald, and Pranay Vaddi, *Reimagining Nuclear Arms Control: A Comprehensive Approach* (Washington, D.C.: Carnegie Endowment for International Peace, December 2021), https://carnegieendowment.org/2021/12/16/reimagining-nuclear-arms-control-comprehensive-approach-pub-85938.

45. Bart Hendrickx, "Peresvet: A Russian Mobile Laser System to Dazzle Enemy Satellites," *Space Review*, June 15, 2020, https://www.thespacereview.com/article/3967/1.

46. 罗曦 [Luo Xi], "大国竞争格局下的国际军控走势" [The trend of international arms control under the pattern of competition among major powers], *解放军报* [PLA daily], July 8, 2021, 11.

ICBMs with no failures and that the satellites could conduct five to seven intercept attempts against each incoming nuclear warhead. They even believe that Starlink satellites could intercept enemy warheads if enough of the satellites smashed into one another to produce a large amount of debris, thus blocking the orbit(s) traveled by enemy warheads.[47] These scenarios likely represent misunderstandings about how the United States intends to employ its space assets, especially its civilian space assets. Nonetheless, such misunderstandings could influence Chinese official thinking about U.S. intentions and China's counterstrategy.

The two sides urgently need to clarify their thinking about their own and each other's capabilities and policies through expert-level exchanges. In the meantime, they can also examine the proposals by independent think tank experts to prohibit the deployment of space-based interceptors.[48] An explicit moratorium on the deployment of space-based interceptors could help reduce both legitimate concerns and misunderstandings about such capabilities.

Another important Chinese incentive to pursue ASAT capabilities is the widespread Chinese perception that other major powers have been developing serious ASAT capabilities for battlefield use by integrating the development of ASAT and missile defense.[49] For instance, they believe the American and Russian missile defense programs are partly driven by a desire to secretly acquire ASAT capabilities. The two technologies do have significant areas of overlap, and missile defense systems—being defensive weaponry—can provide a useful moral and legal justification for the development of such technologies.[50] The perception that the other major powers have an inherent interest in ASAT and that their missile defense programs provide a cover for developing ASAT capabilities could make China

47. 李陆 [Li Lu], 郭莉丽 [Guo Lili], and 王克克 [Wang Keke], "'星链'星座的军事应用分析" [Analysis of the military applications of the "Starlink" constellation], *中国航天* [Aerospace China] (5) (2021): 37–40.

48. See, for example, Acton, Macdonald, and Vaddi, *Reimagining Nuclear Arms Control*.

49. 臧继辉 [Zang Jihui], "简述'反卫星技术'" [Brief description of "anti-satellite technology"], *人民政协报* [Journal of the Chinese people's Political Consultative Conference], June 24, 2021, 7; and 刘海印 [Liu Haiyin], 曹秀云 [Cao Xiuyun], and 李云 [Li Yun], "2015 年国外空间安全重大动向分析" [Analysis of major foreign space security trends in 2015], *中国航天* [Aerospace China] (4) (2016): 23–26.

50. 董正宏 [Dong Zhenghong], 杨帆 [Yang Fan], 陈进军 [Chen Jinjun], and 王俊峰 [Wang Junfeng], "美国应对外空国际条约的做法简析" [A brief analysis of U.S. approaches to international treaties on outer space], *国防科技* [National defense technology] 41 (5) (2020): 79–83.

even more pessimistic about U.S. willingness to limit its missile defense program. Such a perception has also reinforced China's own determination to pursue ASAT capabilities through an integrated approach of simultaneously developing both missile defense and ASAT technologies.[51]

Chinese suspicions are likely one main reason that Beijing has not reacted positively to the Biden administration's announcement of a unilateral moratorium on debris-generating direct-ascent ASAT testing. Beijing thinks Washington already possesses advanced ASAT capabilities through its missile defense programs and can continue developing them under the cover of missile defense. Therefore, Beijing interprets the U.S. moratorium as an effort to prevent Beijing from acquiring ASAT capabilities that Washington already has, leaving a big loophole that Washington can easily exploit.

To address such Chinese suspicions, Washington can further demonstrate its good will by offering to discuss technical measures that can clarify ambiguities and make its moratorium commitment clearer and easier to execute. Such measures should also address Beijing's concern that the moratorium could undermine China's capability to develop missile defenses. Therefore, Washington could consider inviting Beijing to an expert-level discussion about the feasibility of establishing a simple altitude limit above which no kinetic interception testing should take place. They could also discuss the possibility of establishing a more complex set of technical criteria, including not only an altitude limit but also factors such as the direction of interception and the relative speed of the colliding objects. If successful, such joint discussions could enhance Chinese confidence that a more specific ASAT testing moratorium would impose the same technological limits on both countries. In this case, where the two sides decide to set the technical limit would be a result of negotiations in which both countries would likely seek to strike a balance between containing debris generation and minimizing limits on their missile defense and other military developments.

Mitigate the Impact of North Korea

Given the U.S. policy of seeking to develop a strategic missile defense capability against the North Korean missile threat, Pyongyang's growing nuclear and missile capabilities present an increasingly serious reason for Washington not to constrain its strategic missile defense development and for Beijing to protect its nuclear deterrent from perceived U.S. missile defense threats. If North Korea continues to develop and maintain a

51. 臧继辉 [Zang Jihui], "简述'反卫星技术'" [Brief description of "anti-satellite technology"].

credible second-strike capability against the United States—as Kim Jong-un's speech at the Eighth Congress of the Workers' Party of Korea in January 2021 suggests—that could make the trilateral situation intractable.

To maintain a stable U.S.-China nuclear relationship would require that an American strategic missile defense system that aims to effectively defend the U.S. homeland against North Korean missile attack cannot seriously undermine the Chinese capability to launch missiles against the U.S. homeland. This task is all the more daunting because Washington appears to want its missile defense to be capable of intercepting an all-out North Korean first strike, whereas Beijing cannot allow U.S. missile defense to be capable of intercepting even the small fraction of Chinese missiles that would be likely to survive—and thus be available for retaliation against—an American first strike. Assuming both Washington and Beijing have the political will to find a technical solution, they would need to figure out the ideal mix of qualitative and quantitative capabilities that would allow U.S. strategic missile defenses to be effective enough against North Korea but not too threatening toward China.

Whether such a sweet spot can be identified is unknown. Partly, this is because the status of the U.S.-China relationship and the level of mutual political distrust could significantly affect the Chinese understanding of what constitutes "too threatening." That said, two general approaches are available that might yield an answer. The first approach is for Washington and Beijing to work together and ensure the overall size of North Korea's arsenal of nuclear weapons and delivery systems is kept at a very small scale. If the numerical difference between the North Korean and Chinese nuclear arsenals is significant enough, Washington may be able to find that sweet spot in building its strategic missile defenses. To do so, the two sides would need genuine and deep cooperation to contain North Korea's nuclear expansion. In addition, Washington would need to be willing to limit its strategic missile defense, and Beijing would need to clarify what specific quantitative restraints it wants Washington to take and what reciprocal concessions it is willing to make. To prepare for such bilateral coordination, experts from the two sides could conduct a joint study to determine whether it makes sense to try to draw a line that imposes a quantitative limit on the scale of U.S. strategic missile defenses so that it can counter the North Korean threat without becoming too threatening to China. Experts would also need to engage in candid analytical discussions about how to define and measure the "threat" to China's nuclear deterrent. A willingness to participate in such expert-level discussions would indicate a commitment to finding a cooperative solution.

The second approach is to find out whether U.S. strategic missile defense could demonstrate a qualitative distinction in its capability against

North Korean and Chinese ICBMs. Certain types of missile defense technologies may be much more effective against North Korea than against China. For instance, some American experts argue that airborne or surface-based short-range boost-phase interceptors can play this role.[52] Interceptor-bearing aircraft, drones, or vessels would be forward deployed outside North Korea's territorial waters at a distance close enough to intercept North Korean ICBMs during the boost phase but too far to threaten Chinese ICBMs, which are often deployed hundreds if not thousands of kilometers from China's border.

So far no public Chinese analysis of such proposals—let alone an official response—has been offered. Thus, a useful starting point would be for Chinese experts to examine the technical feasibility of such ideas either jointly with their American counterparts or independently in a Chinese study. Among the issues that need further examination are the extent to which the employment of such U.S. missile defense systems would require cooperation or assistance from other countries, like China or Russia. Under certain conditions, for example, the United States may need to deploy short-range, boost-phase interceptors close to the Chinese and Russian border or even to launch interceptors toward Chinese and Russian airspace if North Korean ICBMs transit those countries' airspace. Such issues would also need to be discussed among policy experts from the relevant countries to examine the political acceptability in Russia and China of the U.S. deployment and employment of this defense capability.

Similarly, some Chinese experts have proposed that the United States keep the qualitative capability of its strategic missile defense at a level that could intercept North Korea's rudimentary ICBMs but could not deal with the much more advanced Chinese ICBMs, especially as Chinese ICMBs are likely equipped with sophisticated penetration aids.[53] Given how secretive

52. James E. Goodby and Theodore A. Postol, "A New Boost-Phase Missile Defense System—And Its Diplomatic Uses in the North Korea Dispute," *Bulletin of the Atomic Scientists* 74 (4) (2018): 210–219, https://doi.org/10.1080/00963402.2018.1486578; Dean A. Wilkening, "Airborne Boost-Phase Ballistic Missile Defense," *Science and Global Security* 12 (1–2) (2004): 1–67, https://doi.org/10.1080/08929880490464649; Richard L. Garwin and Theodore A. Postol, "Airborne Patrol to Destroy DPRK ICBMs in Powered Flight" (MIT Science, Technology, and National Security Working Group, Cambridge, Mass., November 27–29, 2017), https://rlg.fas.org/airborne.pdf; and Brian Dunn, "A Technological Path Out of the Missile-Defense Security Dilemma," *Defense One*, March 19, 2019, https://www.defenseone.com/ideas/2019/03/technological-path-out-missile-defense-security-dilemma/155641/.

53. Wu Riqiang, "No Stability without Limits on Missile Defense," *Bulletin of the Atomic Scientists*, September 24, 2014, https://thebulletin.org/roundtable_entry/no-stability-without-limits-on-missile-defense/.

these technologies are, experts from both sides should jointly discuss whether a meaningful distinction can be made regarding different North Korean and Chinese penetration technologies without revealing the vulnerabilities in either the Chinese penetration aids or the U.S. interceptors. Such joint expert studies can take place at the unclassified level using publicly available information and can offer useful insights about whether the proposal by Chinese experts offers a practical solution. Even if a joint discussion shows the proposal is unlikely to work, it would send a helpful message to Beijing that technical challenges—rather than lack of political will—are what prevents Washington from taking certain reassuring measures to address Beijing's concerns.

Reduce Crisis Instability

Another set of issues that has not received much scrutiny involves the risk that missile defense could increase crisis instability between the United States and China. In addition to the classical positions in the literature outlining how strategic defensive weapons in general can affect one's own or one's adversary's propensity toward conflict escalation, the specific thinking and policies of the United States and China could affect the likelihood of conflict initiation and the risk of escalation in several ways.

For instance, the U.S. left-of-launch concept of missile defense seeks to "neutralize offensive missile threats prior to launch" through kinetic strikes or by nonkinetic means such as directed energy weapons, cyber interference, and electronic warfare.[54] China sees this as evidence that the United States is using missile defense as a cover for executing offensive operations in the form of preemptive strikes. This reinforces the Chinese view that the U.S. missile defense program is inherently offensive rather than defensive in nature and that this justifies China's contemplation of a preemptive strike on U.S. missile defense assets during crises. The United States can help mitigate this dangerous dynamic by providing more clarity about the conditions under which it plans to employ left-of-launch capabilities against peer competitors or about the enemy military activities that would trigger U.S. execution of certain left-of-launch operations. Even some elaboration on the differences between left-of-launch and preventive

54. *Department of Defense Appropriations for Fiscal Year 2017: Testimony before the U.S. Senate, Subcommittee of the Committee on Appropriations*, 114th Cong. 2 (2016) (unclassified statement of Vice Admiral J. D. Syring, USN, Director, Missile Defense Agency), https://www.govinfo.gov/app/details/CHRG-114shrg69104707/CHRG-114shrg69104707/context; and U.S. Department of Defense, *2019 Missile Defense Review*.

attack would be helpful, as many Chinese experts have expressed concern that *left-of-launch* is a euphemism for *preventive attack*.

Additionally, China believes that U.S. airborne or ship-based boost-phase interceptors may be particularly prone to causing inadvertent escalations in the U.S.-China context.[55] Such interceptors need to be deployed near their target and launched quickly after detecting a missile launch, leaving little time for information processing and evaluation of the situation. This could increase the risk of mistakenly intercepting a nonthreatening missile launch (e.g., a missile test). The likely need to launch such interceptors into Chinese airspace could also make their employment particularly escalatory. American policy-makers should be made aware of Chinese concerns through bilateral exchanges. U.S. decision-makers could then improve crisis stability by making internal policy development decisions that are informed by Chinese concerns. The two countries could also discuss and debate the merits of technical arguments—the process itself would be a useful confidence-building exercise.

On the Chinese side, its activities to counter U.S. missile defense could lead to inadvertent escalation of a conflict under certain scenarios—the risk of which does not appear to have been systematically analyzed. For example, Chinese experts have discussed conditions under which China might need to attack U.S. early warning satellites to undermine U.S. regional missile defense capabilities during a conventional conflict in East Asia.[56] But a Chinese attack on U.S. early warning satellites might be interpreted by Washington as an attempt to destroy the U.S. NC3 system of which the early warning satellites are a part.[57] In addition to this specific scenario, Chinese experts have discussed various strike options against potentially vulnerable nodes and links in the U.S. missile defense network, including sensors, launchers, interceptors, and command and control, battle management, and communications systems, through both kinetic and nonkinetic means, in what they call "system penetration" or "system

55. 罗曦 [Luo Xi], "美国导弹防御助推段拦截技术及其战略影响" [U.S. missile defense boost-phase intercept technologies and strategic implications].

56. Tong Zhao and Bin Li, "The Underappreciated Risks of Entanglement: A Chinese Perspective," in *Entanglement: Chinese and Russian Perspectives on Non-nuclear Weapons and Nuclear Risks*, ed. James Acton (Washington, D.C.: Carnegie Endowment for International Peace, November 2017), https://carnegieendowment.org/2017/11/08/entanglement-chinese-and-russian-perspectives-on-non-nuclear-weapons-and-nuclear-risks-pub-73162.

57. James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security* 43 (1) (2018): 56–99, https://doi.org/10.1162/isec_a_00320.

confrontation" strategy.[58] Absent any deep understanding about each other's thinking and intentions, these strike options, especially if employed preemptively, could lead to escalation in ways not foreseen by the attacker.

In a situation where key U.S. early warning satellites and ground-based radars are interfered with and even disabled at the same time, Washington might fear the worst about Chinese intentions and choose to significantly escalate the conflict. But even if only one of these two main early warning capabilities is undermined, the United States would still lose the capacity to double-check the authenticity of data provided by the remaining system, and the risk of a false alarm would increase as a result. This risk is made more serious by Chinese thinking that stresses the importance of employing deceptive tactics to enhance China's missile penetration capabilities.

For example, Chinese military experts have argued for setting up false infrared signal sources to distract, overwhelm, or mislead enemy early warning satellites and to make the enemy unable to adequately identify and track the launch of real missiles.[59] Such tactics, if used while U.S. early warning radars are undermined and U.S. early warning satellites have become the only available system, could make it harder for the satellites to produce reliable reports on the location and scale of a Chinese missile launch and thus make U.S. decision-makers more likely to misjudge Chinese intentions and choose inappropriate responses. In many cases, such U.S. misjudgment and inappropriate responses could also hurt China's own interests, although Chinese reflection on such risks appears minimal.

This highlights the need both to raise awareness of the potential risks in one's own internal planning and to build joint understanding between the two countries' military policy communities. As the examples presented in this paper demonstrate, both countries feel anxious about the other's perceived shift toward preemptive use of force, whereas many experts in both countries also increasingly stress the importance of considering preemptive strike options, including in self-perceived defensive operations. A better understanding of each other's thinking is urgently necessary if China and the United States are to address crisis instability. It is also an imperative step for discussing measures of mutual restraint in the future.

58. 汪民乐 [Wang Minle], "弹道导弹突防对策综述" [Overview of ballistic missile penetration countermeasures]; 梁蕾 [Liang Lei], "洲际弹道导弹突防技术发展趋势" [Trends of ICBM penetration technologies development]; and 程强 [Cheng Qiang] and 游敬云 [You Jingyun], "对弹道导弹防御系统的电子对抗技术分析" [Analysis of electronic countermeasures against ballistic missile defense system].

59. 白新有 [Bai Xinyou], 王枭 [Wang Xiao]), and 楚樊星 [Chu Fanxing], "掩护弹道导弹突防支援干扰措施研究" [Research on support jamming measures for covering ballistic missile penetration].

The Indispensable Link:
Strategic Defensive Capabilities as a Cornerstone of Arms Control and Arms Racing

Dmitry Stefanovich

Since the late 1960s, strategic missile defense has been understood as a major factor in nuclear deterrence—and not always a positive one.[1] Debate about its importance and about which details make defense assets "strategic" has continued unabated. Crucially, the balance (and imbalance) of offense and defense has played a significant role in arms races, with perceived imbalance often mattering much more than the actual technical capabilities of adversaries.

The Anti-Ballistic Missile Treaty (ABM Treaty) of 1972 played an important and stabilizing role during the Cold War, an understanding shared by both Moscow and Washington.[2] With the launch of the Strategic Defense Initiative by the Reagan administration, however, attitudes and narratives started to evolve. The Soviet side was extremely concerned by U.S. missile defense research and development (R&D) and took all measures it could to preserve the ABM Treaty. While Soviet R&D programs were launched to overcome future defenses—and to build new Soviet defensive capabilities—concessions were also made.[3] Despite the normalization of relations between the USSR (and later Russia) and the United States during the late 1980s and 1990s, efforts to adapt and preserve the ABM Treaty (including the 1997 Agreed Statements) failed, and the United States eventually withdrew from the treaty. Continued resistance to legal limits on

1. J. P. Scoblic, "Robert McNamara's Logical Legacy," *Arms Control Today* 39 (7) (2009): 58, https://www.armscontrol.org/act/2009_09/lookingback_McNamara.

2. A. Baklitskiy, "Arms Control Is Dead: Long Live Arms Control," Carnegie Moscow Center, March 21, 2019, https://carnegiemoscow.org/commentary/78651.

3. On late Cold War efforts to increase Soviet defenses, see P. Podvig, "Did Star Wars Help End the Cold War? Soviet Response to the SDI Program," *Science and Global Security* 25 (1) (2017): 3–27, https://doi.org/10.1080/08929882.2017.1273665.

missile defense development has fueled worst-case-scenario planning by Russia's military-political leadership.[4]

Currently, the official Russian position on the strategic stability dialogue with the United States is based on the so-called security equation, which includes strategic defensive capabilities (understood primarily as the ABM systems) that must be addressed together with strategic offensive capabilities, both nuclear and nonnuclear.[5] Simultaneously, Russia continues to develop measures to ensure it can penetrate future missile defense systems, as well as to develop and upgrade the Russian "air-space defense" system, which "must detect hypersonic and ballistic targets of all types at long distances and then be able to destroy them along the entire trajectory of their flight."[6]

This paper outlines Russian perceptions of U.S. missile defense efforts, explains current and proposed Russian missile defense capabilities, maps areas of actual and possible cooperation between Russia and China, and offers a list of possible unilateral and joint measures in missile defense that might reduce nuclear risks and strengthen strategic stability. While the war in Ukraine—in which the United States and the North Atlantic Treaty Organization (NATO) are actively supporting Ukrainian armed forces—is a major hurdle, viable alternatives to reengagement on strategic issues are lacking, and officials from both sides continue to emphasize their readiness for such dialogue as soon as their counterparts demonstrate genuine interest.[7]

4. V. Putin, "Presidential Address to the Federal Assembly," March 1, 2018, http://en.kremlin.ru/events/president/news/56957.

5. "Deputy Foreign Minister Sergey Ryabkov's Opening Remarks at a Briefing at the Rossiya Segodnya International Information Agency on Arms Control and Strategic Stability," Russian Ministry of Foreign Affairs, https://www.mid.ru/en/foreign_policy/news/1415641.

6. Putin, "Presidential Address to the Federal Assembly"; and "Meeting with Defence Ministry Leadership and Defence Industry Heads," November 1, 2021, http://en.kremlin.ru/events/president/news/67051.

7. "President Biden Statement Ahead of the 10th Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons," The White House, August 1, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/01/president-biden-statement-ahead-of-the-10th-review-conference-of-the-treaty-on-the-non-proliferation-of-nuclear-weapons/; and Y. Pedanov, "Ryabkov: Rossiya gotova zashchitit' svoi interesy i vypolnit' tseli SVO" [Ryabkov: Russia is ready to protect its interests and fulfill the goals of the NOW], *Mezhdunarodnaya zhizn'* [International affairs], October 20, 2022, https://interaffairs.ru/news/show/37491.

Classic Offense-Defense Link

The basic Russian attitude to how missile defense affects strategic stability is a classic one: defense capabilities of one actor undermine second-strike capabilities of the other one, thus undermining strategic stability by creating incentives for a first strike.[8] This link is present in the preface of the New START Treaty and will likely remain a part of any future strategic arms control accord. However, future arrangements could also mix politically and legally binding agreements, with missile defenses being on the "softer" side of such an architecture, since the passage of legal restrictions on missile defense limits in the United States is improbable. At the same time, because the development of weapons does not stop, the link between missile defense and first-strike counterforce capabilities remains crucial. Among the most concerning trends is the "left-of-launch" concept; that is, the capability to "defeat" a possible missile threat before an actual launch by destroying enough of an adversary's missiles while they are still in/on launchers, thus creating space for "traditional" missile defenses to absorb the adversary's remaining missiles. This concept remains relevant with many American officials and experts and keeps reappearing in official documents and diagrams.[9]

The left-of-launch concept is perceived as a rebranded counterforce posture, with understandable negative connotations for military planners and decision-makers, although in academic and expert communities this perception is more nuanced. The Russian general staff translates *left-of-launch* as "prestart intercept" (*dostartovyi perekhvat*) and considers it an essential part of U.S. missile defense efforts.[10] Russian officials and scholars have been vocal about their concerns with the left-of-launch concept and the development of related capabilities. Hypersonic weapons are perceived as one of the tools for left-of-launch scenarios, but also as an instrument to overcome an adversary's missile defenses.[11]

8. I. Ivanov, "The Missile-Defense Mistake: Undermining Strategic Stability and the ABM Treaty," *Foreign Affairs* 79 (5) (2000): 15, https://doi.org/10.2307/20049885.

9. U.S. Missile Defense Agency, *Budget Estimates Overview FY 2021* (Fort Belvoir, Va.: Missile Defense Agency, 2020), https://www.mda.mil/global/documents/pdf/budgetfy21.pdf.

10. "Genshtab Rossii: SSHA razrabatyvayut 'dostartovyy perekhvat' raket" [Russian General Staff: The United States is developing "prelaunch intercept" missiles], *RIA Novosti*, April 24, 2019, https://ria.ru/20190424/1553010003.html.

11. A. G. Arbatov, ed., *Kontrol' nad vooruzhenijami v novyh voenno-politicheskih i tehnologicheskih uslovijah* [Arms control in the new military-political and technological conditions] (Moscow: IMEMO, 2020), https://doi.org/10.20542/978-5-9535-0576-5; and Putin, "Presidential Address to the Federal Assembly."

Another important scenario is the so-called "cyber" left-of-launch, which has been reported in the media but criticized by scholars.[12] However, even if the ability to prevent missile launches (or even missile development) through cyber means remains questionable, the challenge lies rather in the *perceived* capability, not the actual one. In this case, the state that perceives itself to be a possible target of such operations might find itself in a classic "use-it-or-lose-it" trap; that is, it might decide to use the capabilities at its disposal early rather than risk losing them before they can be used at all, which can lead to a shift toward a more aggressive, preemptive doctrine of force employment (including nuclear forces).[13] The basis of the Russian concern with missile defense is not that it will be able to counter 100 percent of strategic nuclear weapons in a salvo, but that it is designed to minimize the effects of the strategic delivery systems still able to launch after the United States carries out a first counterforce strike—employing a combination of nonnuclear and nuclear weapons "capable of accomplishing strategic tasks," with both becoming more and more precise and thus more lethal.[14] A first counterforce strike would be aimed at nuclear weapons delivery platforms; nuclear command, control, and communications (NC3) nodes and centers; all types of command posts; early warning and missile defense radars; ports and airports (including submarine and heavy bomber bases); and other critical infrastructure.[15]

The developments in strategic nonnuclear strike capabilities lead to several unnerving takeaways. First, they would allow the adversary to achieve at least some strategic aims in the "prenuclear" stage of conflict. Second, such capabilities would "free up" nuclear warheads and delivery systems, resulting in even greater inequality of strategic forces. Third, the potential for an increased but unclear number and type of "incoming"

12. H. Lin and A. Zegart, eds., *Bytes, Bombs, and Spies: The Strategic Dimensions of Offensive Cyber Operations* (Washington, D.C.: Brookings Institution Press, 2018).

13. For more on the "use-it-or-lose-it" trap, see P. Lewis and B. Unal, "The Destabilizing Danger of Cyberattacks on Missile Systems," Chatham House, July 2, 2019, https://www.chathamhouse.org/2019/07/destabilizing-danger-cyberattacks-missile-systems.

14. "Deputy Foreign Minister Sergey Ryabkov's Remarks at the Russia-US Dialogue on Nuclear Issues, Co-organized by the Center for Energy and Security Studies (CENESS) and the James Martin Center for Nonproliferation Studies (CNS)," James Martin Center for Nonproliferation Studies, December 7, 2020, https://nonproliferation.org/wp-content/uploads/2020/12/201207_deputy_foreign_minister_sergey_ryabkov_remarks.pdf.

15. P. Zolotarev, "Possible Approaches to Reducing the Risks of Nuclear Escalation at the Regional Level," *Rossiya i Amerika v 21 veke* [Russia and America in the 21st century] (3) (2021), https://doi.org/10.18254/S207054760017020-9.

munitions, coupled with the unclear and increased capability of missile defenses, would complicate the threat environment for strategic nuclear delivery systems.

In essence, though, these concerns are not about today's or even tomorrow's capabilities, but about the absence of limits on missile defense development for the foreseeable future. Such a situation, in turn, leads to hedging of missile defense penetration capabilities and investment in so-called air-space defenses. While these developments are currently qualitative (although even as such they have already produced several exotic systems), a renewed focus on quantitative improvement is also possible.

Russian Reaction to U.S. Missile Defense Efforts

Russia has been transparent about its possible reaction to the continued development and deployment of U.S. missile defense, especially since the early 2010s. Statements by former Russian President Dmitry Medvedev, presentations by Russian Ministry of Defense officials (and even an international conference), and articles by Russian military scholars have all portrayed a wide array of countermeasures along three main vectors: enhanced missile defense penetration capabilities; strike capabilities aimed at the destruction of missile defense assets, as well as active and passive defenses for national strategic assets, including NC3; and strategic nuclear delivery systems.[16]

In March 2018, when an array of so-called novel Russian strategic delivery systems was publicly revealed by President Putin, Minister of Defense Sergey Shoigu said, "What is being created today in Poland and Romania, in Alaska and is supposed to be created in South Korea and Japan, this 'umbrella' of missile defense turns out to be 'full of holes.'"[17] A similar claim was made by Deputy Prime Minister Yuri Borisov (former deputy

16. D. A. Medvedev, "Statement in Connection with the Situation Concerning the NATO Countries' Missile Defence System in Europe," 2011, http://en.kremlin.ru/events/president/news/13637; Ministry of Defense of the Russian Federation, "Faktor protivoraketnoy oborony v formirovanii novogo prostranstva bezopasnosti" [The factor of missile defense in the formation of a new security space], 2012, https://mil.ru/conference_of_pro/greeting.htm; and V. I. Esin, "Amerikanskaya i rossiyskaya sistemy protivoraketnoy oborony i strategicheskaya stabil'nost'" [American and Russian missile defense systems and strategic stability], *Vestnik Moskovskogo universiteta, Ser. 25: Mezhdunarodnyye otnosheniya i mirovaya politika* [Bulletin of Moscow University, series 25: International relations and world politics] 9 (4) (2017).

17. "Shoygu nazval amerikanskuyu PRO 'dyryavym zontikom'" [Shoigu called the American missile defense "a leaky umbrella"], *RIA Novosti*, March 1, 2018, https://ria.ru/20180301/1515552457.html. For the announcement of the systems, see Putin, "Presidential Address to the Federal Assembly."

of the Ministry of Defense and since July 2022 the head of Roscosmos, the Russian space agency), who asserted that the Russian Avangard hypersonic weapon "devalues the United States' efforts to create a missile defense (ABM) system."[18] Nevertheless, the Russian side cannot be expected to disregard future developments and the role of new technologies and concepts.

The capabilities of all U.S. missile defense assets are gradually increasing, and emerging and disruptive technologies are playing an increasingly important role. Probably the greatest variables are related to the Ground-based Midcourse Defense (GMD) and its next-generation interceptor. When the new kill vehicle will be tested and how capable it will be is unclear, although the United States plans to deploy it by the end of the 2020s.[19] However, the new kill vehicle is likely to follow the pattern of the recently canceled Redesigned Kill Vehicle and Multi-Object Kill Vehicle efforts, which focused on the capability to better discriminate against decoys and to counter several incoming threats simultaneously.[20] If the kill vehicle redesign project is successful and if a long-debated second GMD silo field on the U.S. East Coast becomes a reality, this would present a significant challenge to the ability of Russian (and Chinese) intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs) to reliably deliver nuclear retaliation. At the time of writing, however, none of these issues have been definitively resolved.

The counter-ICBM capability of the SM-3 Block IIA interceptor of the Aegis Ballistic Missile Defense (BMD) system demonstrated in 2020 would allow the United States to rapidly increase its defensive capabilities due to the relatively wide availability of Mark 41 launchers in the U.S. Navy and the possibility of placing new Aegis Ashore installations on the continental United States and elsewhere.[21] Still, this is not yet a viable defense against

18. "Vitse-prem'yer Borisov nazval obestsenivayushcheye PRO SSHA rossiyskoye oruzhiye" [Deputy Prime Minister Borisov called Russian weapons devaluing U.S. missile defense], *Izvestiya*, September 27, 2020, https://iz.ru/1065942/2020-09-27/vitce-premer-borisov-nazval-obestcenivaiushchee-pro-ssha-rossiiskoe-oruzhie.

19. J. Judson, "Next-Gen Intercontinental Ballistic Missile Interceptor Estimated Cost? Nearly $18B," *Defense News*, April 27, 2021, https://www.defensenews.com/pentagon/2021/04/27/next-gen-intercontinental-ballistic-missile-interceptor-estimated-to-cost-nearly-18-billion/.

20. Missile Defense Project, "Ground-Based Interceptor (GBI)," Missile Threat, Center for Strategic and International Studies, April 14, 2016, last modified July 26, 2021, https://missilethreat.csis.org/defsys/gbi/.

21. A. Panda, "A New U.S. Missile Defense Test May Have Increased the Risk of Nuclear War," Carnegie Endowment for International Peace, November 19, 2020, https://carnegieendowment.org/2020/11/19/new-u.s.-missile-defense-test-may-have-increased-risk-of-nuclear-war-pub-83273.

the modern ICBMs Russia is currently deploying. The newer Russian missiles include sophisticated missile defense penetration aid packages that were absent in the ICBM-class target intercepted by the SM-3 Block IIA in 2020.[22] Russian scholars generally agree with this assessment.[23]

Beyond this, radar technology remains somewhat unnoticed. Substantive progress on range and discrimination capabilities may be possible, and machine-learning technologies (and other "AI elements") might dramatically increase the capabilities of ground-based radars, radar satellites, and probably even kill vehicle–based sensors.[24]

The use of directed energy weapons for "strategic" missile defense remains somewhat underdeveloped, but the threat is taken seriously on the Russian side. For example, regular scientific events are held at the Strategic Rocket Forces military academy to develop ways to protect ICBMs from lasers.[25] While details are scarce, the mere fact of such regular events demonstrates how important the issue is perceived to be.

A somewhat underresearched issue is how investments in defensive technologies aimed at new threats (i.e., hypersonic weapons) can affect the "central balance" of strategic nuclear delivery vehicles that assure nuclear deterrence. Technological surprises cannot be ruled out, and solutions developed to counter "hypersonic threats" might eventually undermine the penetration capabilities of the "classic" missiles and thereby effectively destabilize nuclear deterrence between the great powers. Despite this, the currently deployed hypersonic weapons of the Russian armed forces are explicitly justified by the need to overcome adversarial missile defenses.[26]

22. "The Strategic Implications of Layered Missile Defence," *Strategic Comments* 27 (4) (2021): x–xii, https://doi.org/10.1080/13567888.2021.1952780.

23. "SM-3 IIA Are Still Unable to Change Strategic Balance: An Interview with Oleg Krivolapov," *Yaderny kontrol* [Nuclear control] (9) (527) (November 2020): 527, https://web.archive.org/web/20220511083434/https://pircenter.org/articles/2250-6628115.

24. C. T. Lopez, "Vice Admiral Discusses Potential of AI in Missile Defense Testing, Operations," U.S. Department of Defense, August 21, 2021, https://www.defense.gov/Explore/News/Article/Article/2730215/vice-admiral-discusses-potential-of-ai-in-missile-defense-testing-operations/.

25. Ministry of Defense of the Russian Federation, "V Voyennoy Akademii RVSN proshla XXVIII vserossiyskaya nauchno-prakticheskaya konferentsiya" [The XXVIII All-Russian Scientific and Practical Conference has been held in the SRF Military Academy], February 17, 2020, https://structure.mil.ru/structure/forces/strategic_rocket/news/more.htm?id=12276443@egNews.

26. "S giperzvukom nam net ravnykh po moshchi" [With hypersonic weapons, we have no equal in power], *Krasnaya zvezda* [Red star], March 1, 2018, http://archive.redstar.ru/index.php/syria/item/36346-s-giperzvukom-nam-net-ravnykh-po-moshchi.

Russia's Avangard missile system with hypersonic gliding winged reentry vehicle can be classified as a hypersonic glide vehicle (HGV) on an ICBM-type booster (SS-19 ICBM). Research and development of this system allegedly began with the Albatross project in the late 1980s after U.S. President Ronald Reagan announced the Strategic Defense Initiative.[27] Albatross received a substantial push after the United States left the ABM Treaty and was vaguely mentioned by military-political leadership as early as 2004.[28] Deployed in late 2019, the HGV is the first operational strategic hypersonic weapon in the world.[29] To achieve survivability, the weapon is deployed in hardened silos.

Missile defense penetration due to unpredictable and relatively low flight trajectory is the main reason for the HGV program itself, although actual trajectories (including possible skip-glide maneuvers on the border of the atmosphere) have not been made public.

Another hypersonic weapon in the Russian arsenal is the Kinzhal air-launched hypersonic aeroballistic missile (a relative of the 9M723 Iskander-M surface-to-surface aeroballistic missile). With a claimed range of two thousand kilometers (likely including the range of its launcher, the MiG-31K/31I supersonic jet, originally developed as a heavy interceptor), this is not a strategic weapon per se. However, it could be used as a tool to breach surface-based missile defenses (both on land and at sea). The Kinzhal weapon system reached initial operational capability in December 2017.[30] Currently, Kinzhal carriers are a part of the long-range aviation program of the Russian air-space forces, which effectively puts them in a basket separate from tactical missions.[31] Kinzhal is also the only hypersonic weapon to have been used in actual military conflict, with at least one case demonstrating an air/missile defense penetration capability.[32]

27. Podvig, "Did Star Wars Help End the Cold War?"

28. "Istoriya sozdaniya raketnogo kompleksa 'Avangard'" [History of the "Avangard" missile system creation], TASS, December 26, 2018, https://tass.ru/info/5955357.

29. The first Strategic Rocket Forces regiment armed with an Avangard missile system (two launchers) was deployed in the Orenburg region no later than December 2019 as part of the 13th Missile Division, with two more launchers deployed in late 2020. The first regiment was scheduled to be rearmed with six Avangard missiles by the end of 2021. Twelve (two regiments) are planned under the 2027 State Armaments Program.

30. Putin, "Presidential Address to the Federal Assembly."

31. "Ot vozdukhoplavaniya do gospodstva v nebe" [From air-faring to air superiority], *Krasnaya zvezda* [Red star], August 12, 2022, http://redstar.ru/ot-vozduhoplavaniya-do-gospodstva-v-nebe/.

32. "Briefing by Russian Defence Ministry," March 21, 2022, https://eng.mil.ru/en/news_page/country/more.htm?id=12414156@egNews.

Space Capabilities—Perceived from Earth

Fortunately, strike systems are still absent from outer space. Some U.S. Space Force officials claim that some Russian satellites look like space torpedoes, although publicly available proof of such programs is nonexistent.[33] Nonetheless, even unweaponized space is extremely important for missile defense. Intelligence, surveillance, and reconnaissance (ISR) capabilities, early warning systems, targeting for missile interceptors (and for long-range precision strike weapons), and data transmission all enable and enhance Earth-based missile defenses. Russian military planners are extremely concerned about such deployed technologies, especially those that offer left-of-launch capabilities. As recently as 2020, the U.S. Missile Defense Agency (MDA) released diagrams and documents that explicitly mention ISR satellites that can be deployed over "provisional," road-mobile ICBM launchers; that is, the potential targets of "Attack operations (Left of Launch)."[34]

One challenge associated with the proliferation of space-based ISR capabilities is the parallel development of artificial intelligence (AI)–assisted technologies of rapid data analysis. Although continuous satellite monitoring of Russian territory remains a bit too ambitious, 24/7 monitoring of crucial regions (e.g., SSBN bases and road-mobile ICBM bases and patrol areas) might be possible soon. That countermeasures are already being developed suggests that ISR and AI have already taken a seat at the "offense-defense," action-reaction table that is the cross-domain arms race.

Russia considers such developments a major threat and is putting a lot of effort and investment into preventing them from becoming a reality. Its Peresvet battle laser is understood to be "a dazzler" capable of preventing detection and targeting of road-mobile ICBMs.[35] Future counterspace capabilities include S-500 and Nudol' surface-to-air missile systems that, although developed with the missile threat in mind, may be capable of striking targets in space.[36] Moreover, because U.S. aerial early warning and control (AEW&C) and airborne warning and control system (AWACS)

33. Chelsea Gohd, "Everyone Wants a Space Force—But Why?" Space.com, September 11, 2020, https://www.space.com/every-country-wants-space-force.html.

34. U.S. Missile Defense Agency, *Budget Estimates Overview FY 2021*.

35. B. Hendrickx, "Peresvet: A Russian Mobile Laser System to Dazzle Enemy Satellites," *Space Review*, June 15, 2020, https://www.thespacereview.com/article/3967/1.

36. M. Khodarenok, "'Nudol' i 'Prometey': Kogda armiya poluchit novyye sistemy" ["Nudol" and "Prometheus": When the army will receive new systems], Gazeta.ru, June 19, 2020, https://www.gazeta.ru/army/2020/06/19/13123189.shtml.

aircraft are considered priority targets for Russia's long-range SA missile systems (e.g., the S-400), Russian military planners likely also consider U.S. ISR satellites to be targets of systems capable of reaching the relevant altitudes.

Another major concern for Russian officials is the global nature of U.S. missile defense, with strike platforms and sensors distributed across the planet. The launch locations and burnout speeds of interceptors are as important for successful interception as the location of detection and tracking radars. American officials and experts portray the deployment pattern of missile defense assets with little consideration for the Russian perception of this pattern, despite the geographical fact that Russia is almost entirely surrounded by these U.S. assets.[37] In Russia, however, the U.S. deployment pattern has been considered a major issue for many years, and Russian officials have been vocal about it. During one international conference in 2012 that included presentations by top military brass, these concerns were explained through simulation models.[38] Although the simulations are open to challenge, they are a clear example of Russian threat perception. Moreover, unilateral deployment of strategic missile defense assets in various regions of the world is considered not only to negatively affect international, regional, and national security per se but also to undermine efforts to develop multilateral mechanisms to prevent the proliferation of missiles and missile technology.[39] While some of these assets are aimed at regional threats, their mission being to protect U.S. overseas deployments and U.S. allies, the demonstrated launch-on-remote and engage-on-remote capabilities of these assets are also a proof of concept that all U.S. missile defense assets belong to a joint system. A system of such sophistication is, however, vulnerable on multiple fronts and subject to numerous other problems (e.g., reliability) that can be exploited by any adversary—and the means for such exploitation are already being developed.

37. "U.S. Homeland Missile Defense Assets," CSIS Missile Defense Project, March 2017, https://i2.wp.com/missilethreat.csis.org/wp-content/uploads/2017/03/Homeland-Defense-Assets.jpg.

38. V. V. Gerasimov, "Assessment of BMD Global Capabilities," May 3, 2012, https://mil.ru/files/morf/Eng_Gerasimov_Assessment%20of%20BMD%20Global%20capabilities.ppt.

39. "Statement of the Permanent Council of the Collective Security Treaty Organization on military activity in the territories adjacent to the zone of responsibility of the Collective Security Treaty Organization and its impact on Eurasian security," Collective Security Treaty Organization, November 30, 2021, https://odkb-csto.org/upload/iblock/210/210cc8f1a9914c90f5b03dcd680cba48.doc.

Russian Concepts and Programs

Russian missile defense programs, although part of the challenge, can also be part of a solution. Unlike the United States, Russia has no dedicated missile defense agency. Tasks related to missile defense are carried out by the air-space forces and their air and missile defense units. The Russian concept of joint air-space defense includes air defense, missile defense, space forces (including the Sistema Konrolya Kosmicheskogo Prostranstva, SKKP, or Space Control System, for space situational awareness), early warning systems, and Moscow's ABM system.[40] Moreover, as elaborated in a 2021 article in the journal *Military Thought* (published by the Russian Ministry of Defense), this architecture possibly includes a space countermeasures system (Sistema protivodeystviya kosmicheskim sredstvam, SPKS), although the main priority for missile defense development is to protect both the highest command and control layers and strategic nuclear force deployment areas.[41] Russia operates several major strike systems, including upgraded 53T6M interceptors for the Moscow ABM system and future S-500 and Nudol' mobile surface-to-air missiles, with the latter, per some sources, being a capable anti-satellite (ASAT) system as well.[42] An S-500 intercept test was made public in summer 2021, with launch footage (the missile interceptor is blurred in the released video) distributed by the Russian Ministry of Defense.[43]

One of the most interesting recent "revelations" happened during Ministry of Defense discussions of air-space defense tasks set by President Putin in November 2021.[44] Defense Minister Shoigu, listing various weapons systems and emphasizing that production and deployment should be

40. "Vozdushno-kosmicheskaya oborona" [Aerospace defense], Ministry of Defense of the Russian Federation, Dictionary, https://encyclopedia.mil.ru/encyclopedia/dictionary/details.htm?id=4486@morfDictionary.

41. M. N. Kumakshev and A. V. Kravtsov, "Antimissile Defense as an Element in the Strategic Deterrence System of the Russian Federation," *Military Thought* (12) (December 2021): 21–26.

42. On the S-500, see "Nashe nebo nadyozhno zashchishcheno" [Our sky is reliably protected], *Krasnaya zvezda* [Red star], July 7, 2021, http://redstar.ru/nashe-nebo-nadyozhno-zashhishheno/.

43. Ministry of Defense, "Ispytatel'nyye boyevyye strel'by ZRS S-500 na poligone Kapustin Yar" [Test live firing of the S-500 surface-to-air system at the Kapustin Yar test range], July 20, 2021, YouTube video, 0:33, https://youtu.be/C_M6JF13RXw.

44. Putin, "Presidential Address to the Federal Assembly."

accelerated, mentioned an advanced future system: S-550.[45] Subsequent reports citing various anonymous sources in the Russian military industry, as well as the head of Rostec, Sergei Chemezov, suggest that the S-550 is a mobile system with missile defense capabilities that should be able to defeat ICBM-class targets.[46] A Soviet project with the same designator emerged in the late 1980s, although the two projects are barely related, with the current S-550 described as a simplified S-500 with a strict focus on missile defense.

In 2021, an open-source research article suggested that yet another program of strategic missile defense is under development in Russia, namely "Aerostat."[47] While the range of nontraditional sources used in the report (e.g., procurement documents and court cases) raises the possibility that the analyst conflated multiple programs, evidence of an ongoing R&D effort similar to the U.S. GMD is growing, although Aerostat is probably a road-mobile variant.

On a substrategic level, the S-300V family of ground force air defense systems is believed to be quite capable as a regional missile defense system, and the S-500 (part of the 77N6 missile interceptor family) might be "related" to the S-300V (part of the 9M82/9M83 missile interceptor family). The latest version of the latter system, the S-300V4, is capable of defeating tactical short- and medium-range ballistic missiles and outperforms the Patriot PAC-3 system.[48] An earlier modification, the S-300V2, is deployed in the Moscow region, where it is tasked with protecting the Russian capital

45. Ministry of Defense, "Russian Defense Minister Sergei Shoigu Held Another Conference Call with the Leadership of the Armed Forces," November 9, 2021, https://eng.mil.ru/en/news_page/country/more.htm?id=12392797@egNews.

46. "Istochniki raskryli osobennosti novoy zenitnoy raketnoy sistemy S-550" [Sources reveal the features of the new S-550 SAM system], *RIA Novosti*, November 13, 2021, https://ria.ru/20211113/s-550-1758871100.html; "Istochnik: S-550 i S-500 budut vmeste zashchishchat' vazhnyye ob"yekty RF ot giperzvukovykh tseley" [Source: S-550 and S-500 will together protect important facilities of the Russian Federation from hypersonic threats], TASS, November 24, 2021, https://tass.ru/armiya-i-opk/13004679; and "Dal'nost' deystviya raket S-550 uvelichat" [The range of the S-550 missiles will be increased], TASS, November 15, 2021, https://tass.ru/armiya-i-opk/12923685.

47. Bart Hendrickx, "Aerostat: A Russian Long-Range Anti-ballistic Missile System with Possible Counterspace Capabilities," October 11, 2021, *Space Review*, https://www.thespacereview.com/article/4262/1.

48. A. Luzan, "Zenitnaya raketnaya sistema S-300V4—Nadezhnyy strazh neba v XXI veke" [The S-300V4 anti-aircraft missile system is a reliable guardian of the sky in the 21st century], *Vozdushno-kosmicheskaya sfera* [Aerospace sphere] 2 (91) (2017): 12–21.

from "nonstrategic" ballistic missile threats.[49] The capability of the S-300V system to counter nonstrategic ballistic missiles has been acknowledged by scholars from the Vasilevsky Army Air Defence Military Academy.[50] Moreover, an "Abakan" missile defense system was proposed for export and first demonstrated at the Army-2020 Forum. Its appearance and announced specifications suggest it is a "mix" of the S-300V and S-500, with organic radar added to the five-axle transport erector launcher that resembles the TEL associated with the S-500.[51] The 9M82 family of missile launchers was proposed as early as 2004 as the basis for the mobile layer of a missile defense system to protect "large industrial and/or administrative regions of a country."[52]

Finally, in 2012, sources claimed that a next-generation "active protection" system for ICBM silo launchers was under development.[53] A project with similar aims, called "Mozyr," was under development during Soviet days, however its actual capabilities and plans are unclear.[54] A major unknown is how mature is Russia's hit-to-kill technology. The nonnuclear warhead used in Russian interceptors is described as a "high explosive with directed field of fragments" (*oskolochno-fugasnaya boyevaya chast' napravlennogo deystviya*), or "high explosive with controllable fragmentation

49. "Crews of S-300V Anti-aircraft Missile Systems Destroyed a Mock Enemy in the Sky of the Moscow Region," Ministry of Defence of the Russian Federation, September 24, 2021, https://eng.mil.ru/en/news_page/country/more.htm?id=12385490@egNews.

50. S. A. Chizhov, V. V. Nemirovsky, and I. A. Lipatnikov, "Strelba ZRS S-300V po nestrategicheskim ballisticheskim raketam" [Firing S-300V SAM at nonstrategic ballistic missiles], *Sovremennyye problemy proyektirovaniya, proizvodstva i ekspluatatsii radiotekhnicheskikh system* [Modern Problems of Design, Production and Operation of Radio Engineering Systems] (2016): 112–113.

51. M. Barabanov, "Zenitnyy raketnyy kompleks 'Abakan'—Novoye predlozheniye na mirovom oboronnom rynke" ["Abakan" surface-to-air system—A new offering on the global defense market], *Eksport vooruzheniy* [Arms export] 160 (5) (2021): 22–24.

52. I. Ashurbeyli, S. Gladkikh, A. Gor'kov, A. Lemanskiy, S. Ostapenko, P. Sozinov, and Y. Soloviev, "Missile Defense System, Russia," Patent RU42302U1, filed August 18, 2004, and issued November 27, 2004.

53. A. Mikhaylov and D. Balburov, "Posledniy rubezh PRO vooruzhat strelami i sharikami" [The last line of missile defense will be armed with arrows and balls], *Izvestiya*, December 11, 2012, https://iz.ru/news/541076.

54. "Mozyr," dfnc.ru, August 5, 2019, https://dfnc.ru/katalog-vooruzhenij/protivoraketnaya-oborona/mozyr/.

pattern," and the designs for the 9M82, 53T6, and 77N6 may all be similar.[55] Western analysts believe that Russia's nuclear warheads are capable of both air and missile defense; they are, however, in central storage, and their numbers are unknown.[56] The destructive test of an unnamed surface-to-space system against the nonactive *Kosmos-1408* satellite on November 15, 2021, raised many concerns about space security.[57] However, one possibility is that this was not an ASAT test but a missile defense test to prove the maturity of Russia's hit-to-kill technology.

Certain features of modern and next-generation early warning radars—specifically, the Voronezh and future Yakhroma series—may be included in future missile defense systems, but early warning, space control, and missile defense information is generally obtained and shared jointly.[58] The Don-2N radar of the Moscow ABM system is being modernized as well, with emphasis on increased speed and precision of data analysis, and some radars of the older Dunai family are undergoing modernization.[59]

Russia has also begun to pay serious attention to nonballistic threats such as cruise and aeroballistic hypersonic missiles. One of its most important assets in this domain is the Konteiner family of over-the-horizon (OTH) radars, the first of which entered service in 2019–2020 in Mordovia, with more being built in western Russia (Kaliningrad), the Russian Far East (Zeya), and the Arctic.[60] While this system is hardly capable of

55. C. Kopp, "NIEMI/Antey S-300V 9K81/9K81-1/9K81M/MK Self Propelled Air Defence System / SA-12/SA-23 Giant/Gladiator," Technical Report APA-TR-2006-1202, Air Power Australia, 2003, last updated April 2012, http://www.ausairpower.net/APA-Giant-Gladiator.html.

56. P. Podvig, "Very Modest Expectations: Performance of Moscow Missile Defense," October 23, 2012, Russian Strategic Nuclear Forces, October 23, 2012, https://russianforces.org/blog/2012/10/very_modest_expectations_sovie.shtml.

57. "Russian Defence Minister: General of the Army Sergei Shoigu Confirms Successful Test of Anti-satellite System," Ministry of Defence of the Russian Federation, November 16, 2021, https://eng.mil.ru/en/news_page/country/more.htm?id=12394066@egNews. A full discussion of the implictaions of missile defense technolgies for space security is beyond the scope of this paper.

58. "Predyprezhdyon znachit zashishyon" [Forewarned means protected], *Krasnaya zvezda* [Red star], February 15, 2021, http://redstar.ru/preduprezhdyon-znachit-zashhishhyon/.

59. "Nebo stolitsy pod neusypnym kontrolem" [The sky of the capital is under vigilant control], *Krasnaya zvezda* [Red star], July 21, 2021, http://redstar.ru/nebo-stolitsy-pod-neusypnym-kontrolem/.

60. "Russia to Set Up Continuous Radar Field to Track Cruise Missiles," TASS, December 2, 2019, https://tass.com/defense/1094657.

tracking separate incoming threats and providing targeting data, its main mission is to detect the operations of larger aircraft formations and, in case of conflict, missile salvo launches.[61] The concept of using OTH radars for cruise missile defense has also been discussed in the United States.[62]

Russia is also developing substrategic missile defenses, including a regional missile defense system based on a road-mobile weapons platform to cover some cities, infrastructure, and military formations.[63] Since the termination of the Intermediate-Range Nuclear Forces Treaty, this work has become even more important, and new S-300V units have been stationed in the Russian Far East. Whether this development should raise significant concerns for the West is uncertain, however, and the new units have largely followed existing deployment patterns. Moreover, some scholars argue that deploying a nonnuclear missile defense system can contribute to strengthening security, including by removing tension in cases in which early warning systems give false signals.[64]

Unlike the United States, Russia deploys hardly any missile defense assets abroad, with the notable exceptions of a legacy Volga early warning radar in Belarus and an S-400 expeditionary unit in Syria. Nevertheless, Russia has a growing missile defense capability, a trend that might lead both to Russian officials better understanding the U.S. drivers of missile defense development and to U.S. officials taking a greater interest in joint limits (or at least transparency) on existing and future missile defenses. In 2013, a Russian academic argued that specifying and limiting the scope of Russian missile defense within its overall air-space defense efforts might be necessary to limit possible negative impacts on strategic stability, provide protection against real threats, and, to some extent, lay the groundwork

61. "Nebo stolitsy pod neusypnym kontrolem" [The sky of the capital is under vigilant control].

62. T. Karako, I. Williams, W. Rumbaugh, K. Harmon, and M. Strohmeyer, *North America Is a Region, Too: An Integrated, Phased, and Affordable Approach to Air and Missile Defense for the Homeland*, CSIS Missile Defense Project (Washington, D.C.: Center for Strategic and International Studies, July 2022), https://www.csis.org/analysis/north-america-region-too.

63. R. Kretsul and A. Ramm, "Plan 'Perekhvat': Goroda poluchat protivoraketnuyu oboronu" ["Intercept" plan: Cities to get missile defense], *Izvestia*, October 3, 2018, https://iz.ru/795323/roman-kretcul-aleksei-ramm/plan-perekhvat-goroda-poluchat-protivoraketnuiu-oboronu.

64. A. Savel'ev, "Sistema preduprezhdeniya o raketnom napadenii i strategicheskaya stabil'nost" [Ballistic missile early warning system and strategic stability], *Mirovaya ekonomika i mezhdunarodnye otnosheniya* [World economy and international relations] 60 (12) (2016): 40–50, https://doi.org/10.20542/0131-2227-2016-60-12-40-50.

for possible agreement and even cooperation with the United States in this domain.[65]

The Chinese Vector

One result of the unique strategic partnership between Russia and China is growing cooperation, including in some sensitive areas. In July 2000, a joint statement on missile defense was signed by President Putin and Chairman Jiang Zemin calling for preservation of the ABM Treaty and addressing the challenges of nonstrategic missile defense undermining security and stability.[66] Since then, mutual understanding of the threats in this domain has grown. The 2021 joint statement of the Russian Federation and the People's Republic of China commemorating the twentieth anniversary of the Treaty of Good-Neighborliness and Friendly Cooperation includes a paragraph related to missile defense, with direct blame assigned to the United States for undermining "international and regional security and global strategic stability" with its development and global deployment of missile defense capabilities (and concomitant efforts to increase the capabilities of its long-range nonnuclear weapons).[67] Similar points were reiterated in a joint Russian-Chinese statement issued in early 2022 expressing "concern over the advancement of U.S. plans to develop global missile defense and deploy its elements in various regions of the world, combined with capacity building of high-precision non-nuclear weapons for disarming strikes and other strategic objectives."[68]

65. A. Arbatov, "Protivoraketnaya filosofiya" [Missile defense philosophy], *Nezavisimoye voyennoye obozreniye* [Independent military review], May 31, 2013, https://nvo.ng.ru/concepts/2013-05-31/1_contr_rockets.html.

66. "Sovmestnoye zayavleniye Prezidenta Rossiyskoy Federatsii V.V. Putina i Predsedatelya Kitayskoy Narodnoy Respubliki TSzyan TSzeminya po voprosam protivoraketnoy oborony Prezident Rossiyskoy Federatsii i Predsedatel' Kitayskoy" [Joint statement of the President of the Russian Federation Vladimir Putin and Chairman of the People's Republic of China Jiang Zemin on missile defense], July 19, 2000, https://docs.cntd.ru/document/901764968.

67. "Joint Statement of the Russian Federation and the People's Republic of China on the Twentieth Anniversary of the Treaty of Good Neighbourliness and Friendly Cooperation between the Russian Federation and the People's Republic of China," June 28, 2021, http://static.kremlin.ru/media/events/files/en/Bo3RF3JzGDvMAPjHBQAuSemVPWTEvb3c.pdf.

68. "Joint Statement of the Russian Federation and the People's Republic of China on the International Relations Entering a New Era and the Global Sustainable Development," February 4, 2022, http://en.kremlin.ru/supplement/5770.

Russia has exported air and missile defense systems (S-300PMU, S-400), as well as radars (including OTH and space tracking), directly to China.[69] Since 2019, it has been public knowledge that Russia provided support to the development of Chinese early warning capabilities.[70] That support may have been limited (at least thus far) to the layout of the Chinese system. Nevertheless, early warning is inherently related to missile defense.

As for missile defense systems per se, Russian and Chinese service personnel have completed several "computer" exercises in this area.[71] Such exercises include joint planning of operations to organize air and missile defenses, command and control, joint firing, and the response to accidental and provocative attacks by ballistic and cruise missiles against Russian and Chinese territory. Related to this is the extended Agreement on Notification of Launches of Ballistic Missile and Space Launch Vehicles between Russia and China.[72] While the primary intent of the agreement is bilateral confidence building and transparency, Russia has explicitly contextualized its importance by citing U.S. efforts to deploy global missile defense capabilities.[73] This—along with growing military competition between China and the United States and the lack of deescalation between Russia and the

69. On the radar exports, see A. Gabuyev and V. Kashin, *Vooruzhennaya druzhba: kak Rossiya i Kitay torguyut oruzhiyem* [Armed friendship: How Russia and China trade in arms] (Moscow: Carnegie Moscow Center, November 2017), https://carnegie.ru/2017/11/02/ru-pub-74601; and "Nauchnaya shkola: Razrabotka i sozdaniye sredstv nadgorizontnoy radiolokatsii v interesakh SPRN, SKKP I PRO" [Scientific school: Development and creation of means of over-the-horizon radar in the interests of EWS, SKKP and PRO], *Uspekhi sovremennoy radioelektroniki* [Advances in modern radio electronics] (9) (2016): 6–8.

70. D. Stefanovich, "Russia to Help China Develop an Early Warning System," *The Diplomat*, October 25, 2019, https://thediplomat.com/2019/10/russia-to-help-china-develop-an-early-warning-system/.

71. "Komandno-shtabnyye ucheniya Kitaya i Rossii po PRO proydut v 2019 godu v RF" [China and Russia missile defense command post exercises to be held in Russia in 2019], TASS, April 25, 2019, https://tass.ru/mezhdunarodnaya-panorama/6375197.

72. "Soglasheniye mezhdu Pravitel'stvom Rossiyskoy Federatsii i Pravitel'stvom Kitayskoy Narodnoy Respubliki ob uvedomleniyakh o puskakh ballisticheskikh raket i kosmicheskikh raket-nositeley" [Agreement between the Government of the Russian Federation and the Government of the People's Republic of China on notification of launches of ballistic missile and space launch vehicles], https://docs.cntd.ru/document/902196991.

73. "Ministr oborony RF Sergey Shoygu vstretilsya po videosvyazi s ministrom oborony Kitaya Vey Fenkhe" [Russian Defense Minister: Sergei Shoigu met via video link with Chinese Defense Minister Wei Fenghe], December 15, 2020, https://function.mil.ru/news_page/country/more.htm?id=12330321@egNews.

West—suggests that further developments in the same direction can be expected.

While details of the impact that the development of Chinese missile defense capabilities (including those with Russian support) might have on strategic stability are rarely discussed, such developments are cited among the reasons necessitating the future multilateralization of "strategic" arms control and the broadening of its scope toward missile defense and nonnuclear long-range precision weapons.[74] The overall scope of Chinese air and missile defense development is being researched by Russian experts as well.[75] Missile defense, with a focus on countering ICBM-class threats, is considered to be a priority for Chinese development efforts by some Russian authors.[76] However, the explicit link between growing Chinese missile defense capabilities and Russian national security and foreign policy interests remains underresearched in the West. Conversely, the role of U.S. regional missile defense as a deterrence tool against both Russia and China and debates around this issue are being studied by Russian scholars, although without final judgments so far.[77]

74. S. V. Golubchikov, "Razvitiye strategicheskoy sostavlyayushchey VMS i PRO Kitaya" [Development of the strategic component of the Chinese naval and missile defense system], *Morskoy sbornik* [Sea collection] 9 (2022) (2015): 61–68, https://www.elibrary.ru/item.asp?id=24149061.

75. S. V. Golubchikov, G. B. Gurov, M. V. Zhesthev, V. I. Kolesnichenko, and V. K. Novikov, "Razvitiye protivovozdushnoy i protivoraketnoy oborony Kitaya" [Development of air and missile defense in China], *Vestnik vozdushno-kosmicheskoy oborony* [Journal of aerospace defense] 4 (2017): 117–123, https://www.elibrary.ru/item.asp?id=30706999.

76. P. Andreyev, "Sostoyaniye i perspektivy razvitiya sistemy protivovozdushnoy oborony Kitaya" [State and development prospects of China's air defense system], *Zarubezhnoye voyennoye obozreniye* [Foreign military review] (7) (2020): 52–58, http://factmil.com/publ/strana/kitaj/sostojanie_i_perspektivy_razvitija_sistemy_protivovozdushnoj_oborony_kitaja_2020/59-1-0-1781.

77. O. O. Krivolapov, "Diskussii o roli amerikanskoy PRO teatra voyennykh deystviy v regional'nom sderzhivanii Rossii i Kitaya" [Debates on the role of U.S. theater missile defense in regional deterrence of Russia and China], *Vestnik Moskovskogo universiteta, Ser. 25: Mezhdunarodnyye otnosheniya i mirovaya politika* [Bulletin of Moscow University, ser. 25: International relations and world politics] 13 (1) (2021): 58–84, https://doi.org/10.48015/2076-7404-2021-13-1-58-84.

Prospects for Future Arrangements

Where do we go from here, and what should we do next? To help answer these questions, the overall issue can be separated into several building blocks.

First, a frank Track I discussion is required. Currently, negotiations are at a deadlock, with Russian officials saying that missile defense must be part of the future security equation and most U.S. officials saying that it is off the table.[78] This leads us nowhere, and, worst of all, it does not give officials on either side any incentive to engage in a joint search for solutions. To overcome this challenge, language that creates a new opening might prove useful. For example, shifting from a focus on "missile defense" as a broad issue, as it is currently discussed, to "undermining of second strike capability" might help the two sides define the actual problems and issues. If Russia and the United States could achieve mutual understanding of which technical capabilities are of concern to which nation, they could then agree to greater transparency in future development plans, although setting actual hard limits is unlikely. The Russia-U.S. consultations within the scope of the Strategic Stability Dialogue launched after the summer 2020 presidential summit in Geneva gave a glimmer of hope. Although we have no insights into how missile defense was discussed, the topic clearly was on the agenda.[79] Moscow might be as willing "to give" as "to take," and, as history shows (most notably in the so-called Krasnoyarsk radar case, which was dismantled because the United States argued it violated the ABM Treaty provision on nondeployment of large phased-array radars deep inside one's territory), Moscow might be ready to address Washington's concerns.[80] Some Russian analysts suggest shifting attention from the relatively toxic topic of the U.S. GMD—unrestrained development of which

78. "Deputy Foreign Minister Sergey Ryabkov's remarks at the Russia-US Dialogue on Nuclear Issues, co-organized by the Center for Energy and Security Studies (CENESS) and the James Martin Center for Nonproliferation Studies (CNS)," December 7, 2020, https://nonproliferation.org/wp-content/uploads/2020/12/201207_deputy_foreign_minister_sergey_ryabkov_remarks.pdf; and Kingston Reif and Shannon Bugos, "U.S., Russia Expected to Continue Stability Talks," *Arms Control Today*, September 2021, https://www.armscontrol.org/act/2021-09/news/us-russia-expected-continue-stability-talks.

79. "US Won't Be Able to Create 100%-Protective Missile Defense, Russian Senior Diplomat Says," TASS, November 2, 2021, https://tass.com/defense/1357267.

80. On the Krasnoyarsk radar case, see Pavel Podvig and Amy F. Woolf, *Monitoring, Verification, and Compliance Resolution in US-Russian Arms Control*, WMDCE Series Paper no. 5 (Geneva: United Nations Institute for Disarmament Research, 2019), https://doi.org/10.37559/WMD/19/WMDCE5.

enjoys broad support in the United States—to out-of-national-territory mobile missile defense platforms.[81] Others argue for an option to delink missile defense from the "START process" and begin with an additional transparency level focused on relevant research and development efforts.[82]

Second, the United States could unilaterally, outside its bilateral discussions with Russia, use more technical and less bellicose language in its next missile defense review. This relatively simple change would be beneficial to all. On the Russian side, one can only hope that something like a Basic Principles of State Policy on Air Space Defense will be prepared and released. No one expected Russia to publicize its Basic Principles of State Policy on Nuclear Deterrence in 2020,[83] so greater symmetry in available declaratory missile/air/space defense policy documents could become a reality. Having "symmetrical" documents prepared and published by other countries, including China, would be helpful as well. Of course, declaratory policies might be considered less important than actual military capabilities and deployments. However, such policies can and should be used to assess and better understand how one's partner (or adversary) thinks about such issues, even if their actions somewhat contradict their documents.

Third, academics and other experts need to hold regular and highly specific exchanges on the technical capabilities of missile defense assets, planned developments, and mutual concerns, as well as the drivers behind ongoing trends.

Finally, the role of space in missile defense deserves its own discussion. While the deployment of a space intercept layer is a major destabilizing possibility, even existing space-based ISR capabilities are a major concern, especially if they enhance "left-of-launch" capabilities. The link between ASAT and ABM capabilities, which are next to impossible to distinguish, only heightens such concerns.

One crucial opportunity that might pave the way toward a new era of arms control is Russia's seeming openness to "non-legally binding"—that

81. A. A. Baklitskiy, "Solving the Strategic Equation: Integrating Missile Defense and Conventional Weapons in U.S.-Russian Arms Control," *Journal of International Analytics* 11 (4) (2020): 39–55, https://www.interanalytics.org/jour/article/view/324.

82. K. V. Bogdanov, "A Hybrid Matryoshka and a Monastery," *Russia in Global Affairs* 19 (3) (2021): 116–136, https://doi.org/10.31278/1810-6374-2021-19-3-116-136.

83. Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence, https://archive.mid.ru/en/web/guest/foreign_policy/international_safety/disarmament/-/asset_publisher/rp0fiUBmANaH/content/id/4152094.

is, "politically binding"—agreements as a "second-best scenario."[84] Missile defense remains a challenge for international and national security alike. It presents technical hurdles, drives the arms race, and is an irritant to the smooth operation of diplomacy. However, the original 1972 ABM Treaty was not an easy thing to achieve, and on the road to its creation Moscow and Washington had to overcome serious conceptual differences. We might not see a similar document anytime soon, or at all, but addressing misperceptions and misunderstandings is a task of paramount importance.

84. E. Chernenko, "'My ne igrayem v politicheskiye igry vokrug strategicheskoy stabil'nosti': Zamglavy MID RF Sergey Ryabkov o predstoyashchikh konsul'tatsiyakh s SSHA" ["We do not play political games around strategic stability": Russian Deputy Foreign Minister Sergei Ryabkov on upcoming consultations with the United States], *Kommersant*, September 9, 2021, https://www.kommersant.ru/doc/4977767.

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