



DTRA • STRATEGIC TRENDS RESEARCH INITIATIVE (STRI)

STUDIES

COMPETITION WITH REVISIONIST POWERS



COUNTERING EMERGING RUSSIAN AND CHINESE HYPERSONIC THREATS

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PROBLEM STATEMENT AND RESEARCH OBJECTIVE

This study assesses the hypersonic capabilities and strategies that the Russian Federation and the People's Republic of China (PRC) could plausibly deploy over the next decade. It further evaluates the implications for sustaining U.S. operational advantages, particularly in Europe and the Indo-Pacific region, to inform future U.S. national security operations, activities, and investments.

The major sections of this manuscript cover:

- the strategic and regional implications of Russian and Chinese hypersonic capabilities;
- similarities and differences in Russian and Chinese hypersonic programs and concepts of operations;
- potential Sino-Russian collaboration regarding hypersonic systems;
- possible hypersonic-related Russian or Chinese assistance to other plausible U.S. adversaries, such as Iran and North Korea; and
- U.S. actions to mitigate these threats.

Developments in all these dimensions could transform the Weapons of Mass Destruction (WMD) threat to the United States and its allies. Since most hypersonic delivery vehicles are inherently “dual-use” systems that can carry either conventional or nuclear warheads, DTRA will play a critical role in the U.S. efforts to mitigate these challenges. This report therefore offers concrete recommendations for addressing how DTRA, U.S. Combatant Commands (CCMDs), and other Department of Defense (DoD) elements can realize the objectives specified in the 2018 U.S. National Defense Strategy (NDS), despite the expanding Russian and Chinese hypersonic capabilities and activities.

The study draws primarily on the substantial body of unclassified Russian, Chinese, and Western sources to evaluate Russia's and China's hypersonic capabilities. Both countries have become more open about their hypersonic technologies in recent years as they seek to communicate deterrence threats and coercive signals to other countries as well as emphasize military prowess to domestic audiences. In addition, civilian and military experts on hypersonic weaponry generously shared their insights.

WHY RUSSIA AND CHINA PURSUE HYPERSONIC CAPABILITIES

The NDS identifies the reemergence of long-term, great power competition with both Russia and China as a central challenge for U.S. security. The operationalization of Russian and Chinese hypersonic delivery technologies represents a new element in this competition. In 2019, Acting Secretary of Defense Shanahan observed that, “For decades, the U.S. led the world in hypersonics research—and deliberately chose not to weaponize these systems. China and Russia have chosen differently.”¹ The attractiveness of hypersonic delivery vehicles for Russia and China is that they could provide military advantages to both states at the strategic (intercontinental) and regional (theater) levels. In particular, these systems can assist Russia and China, across the nuclear-conventional escalation ladder, to:

- defeat U.S. forces in wartime;
- deter U.S. attacks on their national territories;
- prevent U.S. military intervention within their regional spheres of influence;
- challenge the credibility of U.S. nuclear and conventional security guarantees to U.S. allies and partners;
- hold U.S. overseas bases, and the forces stationed there, at risk; and

- provide additional means for peacetime coercion of U.S. allies and other countries.

Russia's and China's hypersonic delivery vehicles—including both hypersonic glide vehicles (HGV) launched on ballistic missiles and air-breathing hypersonic cruise missiles (HCM)—complement their other offensive strike capabilities. Since hypersonic systems pose a different threat profile than their existing missiles, they can hold U.S. assets at risk in new or different ways, which could change when and how Russia and China may launch strikes against U.S. targets. In particular, they can circumvent some aspects of present-day U.S. Ballistic Missile Defense (BMD) systems due to their combination of sustained rapid speed (Mach 5 or faster), maneuverability, unpredictable flight paths, and other characteristics.² Their hypersonic systems can degrade adversaries' capabilities early in conflicts by removing critical systems from the battlefield, such as forward-based strike weapons and missile defenses. They thereby enable follow-on attacks by Russia's and China's many non-hypersonic delivery systems. These challenges to the U.S. homeland, forces, facilities, and military dominance in warfighting domains intensify when adversarial delivery systems carry nuclear warheads.

Strategic Considerations

Nuclear-armed hypersonic missiles provide Moscow and Beijing additional means to reinforce deterrence of the United States by threatening the U.S. homeland. This strategic threat arises from both their intercontinental-range delivery systems and their intermediate-range hypersonic missiles launched from planes and ships within range of the Continental United States (CONUS). Having a capacity to threaten offensive and retaliatory strikes against the U.S. homeland, with even a small number of nuclear-armed hypersonic weapons, could enhance Russia's and China's capacity to deter U.S. attacks against their national territories. In this regard, Russian and PRC doubts about their assured deterrence capacity has amplified their investment in offensive strike hypersonic delivery systems. In their view, the United States could use, or threaten to use, its offensive nuclear forces, missile defenses, and conventional precision-strike capabilities to preemptively attack Russia's or China's nuclear forces, command-and-control systems, and other strategic capabilities. In this situation, the United States could seriously degrade Russia's or China's nuclear deterrent. By providing additional means to overcome U.S. missile defenses, hypersonic delivery vehicles could help Moscow and Beijing prevent this decapitating strike scenario.

Russian and Chinese policymakers also expect that, by increasing the threat to the U.S. homeland, they could decrease the U.S. willingness to defend U.S. allies and partners. The elevated threat to the U.S. homeland from Russian and PRC hypersonic strike systems results from both the damage they can inflict through a deliberate attack and the increased risks of escalation they pose in limited nuclear and major conventional conflicts. Highly accurate, conventionally armed hypersonic delivery systems could also allow Russia and China to threaten high-value U.S. targets without having to increase their number of offensive warheads or delivery vehicles.³ They could also give Russia and China a global prompt strike capacity currently enjoyed by only the U.S. military due to its worldwide network of military bases and forces.⁴ If Moscow and Beijing succeed in dissuading the United States from aiding other countries threatened by Russian and Chinese coercion, these hypersonic capabilities could challenge the credibility of U.S. security guarantees to these states.

For decades, the Soviet and Russian governments have adamantly pursued hypersonic technologies to overcome U.S. BMD capabilities despite financial and technical setbacks. The Soviet Union launched its strategic hypersonic research & development (R&D) program after the United States began its Strategic Defense Initiative to build a comprehensive defense system against Soviet missiles.⁵ In a March 2018 speech, Russian President Vladimir Putin confirmed Russia's progress on several strategic weapons projects, including the Avangard HGV.⁶ In December 2019, Putin, referencing Russia's recent deployment of the Avangard, boasted that his country was leading the development of a crucial military capability for the first time since World War II.⁷ China may develop

intercontinental HGVs in the future. In February 2020, U.S. Northern Command (USNORTHCOM) Commander Gen. Terrence O'Shaughnessy said China was "testing...an intercontinental-range hypersonic glide vehicle—similar to...Avangard."⁸

Regional Considerations

At the theater level, intermediate-range hypersonic delivery systems could help Russia and China attack U.S. forces and facilities in critical regions, which for Moscow is primarily Europe, and, for Beijing, essentially the Indo-Pacific region. Russian and Chinese hypersonic cruise and ballistic missiles, armed with conventional or nuclear payloads, can decrease U.S. power projection by augmenting adversarial Anti-Access/Area Denial (A2/AD) capabilities. The missiles' high speed would give defenders less time to respond than slower flying systems, an advantage for attacking time-sensitive, mobile, or high-value targets than non-hypersonic missiles or planes. In addition to U.S. and allied forces, hypersonic strike systems can degrade U.S. command, control, and transportation facilities in foreign countries, thereby compromising the U.S. ability to use these ports, airfields, and other infrastructure for defensive operations. Moreover, since hypersonic cruise missiles could reach distant targets in substantially less time than subsonic systems such as the U.S. Tomahawk, they will also bolster Russia's and China's capacity to wage long-range conventional salvo engagements. Additionally, the missiles' maneuverability can complicate efforts to track and intercept them, especially if they could fly below the targeting range of endo-atmospheric BMD.⁹ These characteristics could worsen strategic stability. By potentially making Russian and Chinese decisionmakers more confident about successfully employing force, making rapid war gains, and deterring or defeating U.S. counteractions, hypersonic delivery systems could raise the risks of regional crises and wars as well as weaken the credibility of U.S. and allied conventional deterrence. Furthermore, hypersonic capabilities provide Russia and China additional means for peacetime coercion of U.S. allies and other countries to realign their policies in line with Moscow's and Beijing's preferences. For example, Russia and China can brandish hypersonic missiles to discourage neighboring countries from hosting advanced U.S. offensive and defensive systems by making them more vulnerable targets.

The Russian military is equipping many naval and air force platforms with hypersonic missiles. With conventional or nuclear payloads, these delivery systems could carry out decisive preemptive strikes against high-value U.S. targets such as aircraft carriers, ports, and command posts. Russia's hypersonic weapons, of varying speeds and ranges, combined with the country's already extensive portfolio of non-hypersonic strike systems, will further complicate CCMD defenses. The Russian Navy is equipping its submarines, cruisers, destroyers, frigates, and other warships with a universal vertical launch platform, which can fire multiple subsonic, supersonic, or hypersonic anti-ship and land-attack cruise missiles.¹⁰ The Navy even aims to equip many of its smaller vessels with hypersonic missiles, such as coastal defense ships, to give them long-range strike capacities.¹¹ The Russian Navy has traditionally acquired long-range anti-ship missiles to compensate for its conventional inferiority versus the U.S. Navy, such as the paucity of Russian operational aircraft carriers. Having anti-ship hypersonic weapons will also enhance Russian A2/AD capabilities in the Baltic Sea, Black Sea, White Sea, Mediterranean, and Northern Pacific. The Russian Air Force is arming its warplanes with precision-strike hypersonic systems that can overcome U.S. air, missile, and ship defenses. The Kh-47M2 Kinzhal "Dagger" Air-Launched Ballistic Missile (ALBM), or variants based on it, will arm many Russian fighters and bombers. The Air Force has already deployed the missile on a modified 1,000km-range Mikoyan MiG-31K Soviet-era supersonic aircraft, which has a large payload capacity for standoff strikes against land and sea targets. By 2024, the military plans to base a fully operational MiG-31 Fighter Aviation Regiment at Kansk in Russia's Central Military District.¹² From this location, the planes can rapidly re-deploy to Russia's upgraded Arctic bases and other regions.¹³ The Kinzhal will also be deployed on next-generation fighters, such as the Su-57, as well as possibly Russia's Tu-160 Blackjack supersonic bombers, which have a large payload and 15,000km range. There are also plans to add

future hypersonic missiles to upgraded 2,000km-range Tu-22M3 “Backfire” supersonic bombers.¹⁴ These fighter and bomber capabilities would be complementary. While bombers have longer ranges, fighters generally have superior survivability.

The Chinese People’s Liberation Army (PLA) is developing new platforms for its novel, theater-range hypersonic delivery systems targeted against U.S. forward-based forces, facilities, and allies. Hypersonic delivery vehicles substantially bolster Beijing’s A2/AD capabilities designed to thwart U.S. power projection in the Indo-Pacific region. They supplement the PLA’s already large and diverse missile portfolio and enhance its ability to strike U.S. bases and forces throughout the Western Pacific.¹⁵ As noted, due to their speed and maneuverability, hypersonic delivery systems can more effectively overcome U.S. air, sea, and land-based defenses in comparison to the PLA’s existing weapons. The DoD Indo-Pacific Strategy Report observes that, “China is also developing a wide array of A2/AD capabilities, which could be used to prevent countries from operating in areas near China’s periphery, including the maritime and air domains that are open to use by all countries.”¹⁶ PRC policymakers perceive these systems as helping prevent U.S. military intervention within Beijing’s declared sphere of influence, weaken U.S. deterrence and defense capabilities, and compel U.S. allies, partners, and other states to realign their policies more closely to Beijing’s liking.

COMPARING RUSSIAN AND CHINESE HYPERSONIC EFFORTS

The Russian and Chinese approaches to hypersonic capabilities are similar in many respects. Both countries are pursuing a broad portfolio of hypersonic capabilities, including HGVs and HCMs of varying ranges, for a wide range of potential contingencies. They see hypersonic capabilities as asymmetric instruments to negate U.S. military advantages by striking U.S. missile defenses, command-and-control centers, air and sea bases, logistical hubs, U.S. forward-operating forces, and other high-value targets. In their hypersonic development trajectories, both countries began with surface-to-surface missiles and then progressed, often by modifying these ground-attack capabilities, to developing sea-launched systems. When developing their systems, Chinese scholars actively studied Russia’s hypersonic weaponry R&D.¹⁷ Both Russian and PRC leaders display novel hypersonic capabilities in high-profile prestige events, amplified by their information ecospheres, to attract the attention of domestic and foreign audiences.

Despite these similarities, the Russian and Chinese hypersonic capabilities and operational concepts diverge in essential aspects. The Russian hypersonic R&D and deployment programs began earlier, but the PLA has had years to develop and deploy ground-launched, intermediate-range cruise and ballistic missiles. The recently expired Intermediate-Range Nuclear Forces (INF) Treaty prohibited Russia from overtly building these types of missiles. Furthermore, whereas China is equipping only modern platforms with hypersonic weapons, Russia, like the United States, envisions hypersonic technologies as means to revitalize Cold War-era warplanes and warships as well as to enhance new platforms.¹⁸ Russia has been seeking both niche strategic systems (e.g., Avangard) and widely distributed operational-tactical systems (e.g., Tsirkon). Although all three militaries are presently developing a range of air, sea, and ground-launched theater-range hypersonic weaponry, Russia still prioritizes strategic nuclear deterrence more than China and the United States. Only Russia is presently threatening CONUS with hypersonic systems. Not only has Moscow declared its intercontinental-range Avangard strategic system operational, but Russia’s MiG-31 can sortie from their Arctic bases and attack the Ground-Based Interceptors in Alaska as well as the Thule Air Base in Greenland with their ALBMs. Putin has also suggested Russia might position hypersonic nuclear missiles on submarines near U.S. waters if the United States places intermediate-range missiles near Russia’s borders.¹⁹ The PLA has not yet tested an intercontinental-range hypersonic missile. Unlike Russia, China’s hypersonic weapons are designed primarily for the Indo-Pacific region. The PRC has pursued advanced railgun and “waverider” self-propelling technology prototypes more actively than Russia.²⁰

As with many of its strike systems, Russia is presently arming many hypersonic delivery systems with nuclear warheads. Not only do nuclear munitions have a greater physical and psychological impact, but they could compensate for the limited precision of Russian delivery systems and their vulnerabilities to U.S. defenses. If even a single strike missile overcomes adversarial defenses and lands near a target, the nuclear detonation will destroy it. In Russian operational thought, hypersonic weapons with nuclear or conventional payloads could serve as first-strike weapons, used in conjunction with large-scale cyber and electronic warfare, to blind and paralyze adversaries as well as facilitate penetration by non-hypersonic strike systems. Furthermore, despite Moscow's perennial denunciations of U.S. BMD efforts, the Russian government is the only country that has launched a comprehensive national defense R&D program against hypersonic missiles.²¹ In a March 2020 test, the S-400 "Triumf" supposedly demonstrated a capacity to intercept hypersonic targets.²² The more advanced S-500 Prometheus (aka 55R6M or "Triumfator-M"), which is now entering into service, has a stated 600km range and ability to hit hypersonic targets in near-Earth space.²³ The declared Russian goal is to have an operational national hypersonic defense system before the United States deploys hypersonic missiles capable of attacking the Russian homeland.²⁴ Until now, the PRC has not made hypersonic defenses a declared priority, though this might change, especially if Russia provides some assistance.

The limited mirror-imaging between Russia and China in the hypersonic domain reflects the two countries' dissimilar military-industrial structures, political-military strategies, and regional security environments. The Soviet legacy has strongly impacted Russia's hypersonic programs. Many of these build on previous Soviet R&D efforts.²⁵ Unlike Russia and the United States, the PRC has only recently launched a comprehensive effort to develop hypersonic weapons—but this undertaking has been massive. During the past decade, China has invested in many new hypersonic test facilities, including large wind tunnels, and constructing new hypersonic test vehicles, the Lingyun-1 and the MF-1, to assess scramjet propulsion.²⁶ The large number of PRC prototypes has allowed Chinese scientists to evaluate how various aerodynamic features can affect flight performance; these insights help develop new hypersonic vehicles and concepts of operations.²⁷ The Chinese approach draws on the PRC's unique civil-military fusion complex, which coordinates contributions from many entities: academic and science bodies conducting basic research, industry and military institutions executing applied development, and government and party bodies overseeing the deployment of hypersonic weapons. The two countries' strategies for competing with the United States also influence their portfolio of hypersonic capabilities. The Russian government prioritizes maintaining strategic parity with the United States, whereas the PRC leadership focuses mostly on achieving regional military advantages.

	Russia	China	The United States
Initiation	<ul style="list-style-type: none"> Sustained since Cold War 	<ul style="list-style-type: none"> Accelerated in last decade 	<ul style="list-style-type: none"> Episodic interest, programs, and funding
Objectives	<ul style="list-style-type: none"> Asymmetric capabilities to negate U.S. military advantages Targets include U.S. forward-operating forces, facilities, and other high-value assets. 		<ul style="list-style-type: none"> Prompt strike of high-value targets as well as countering adversary A2/AD
	<ul style="list-style-type: none"> National hypersonic missile defense 	<ul style="list-style-type: none"> Coerce U.S. allies, partners, and other states to include not hosting U.S. BMD 	<ul style="list-style-type: none"> Extend BMD to this domain
Munition	<ul style="list-style-type: none"> Many with nuclear weapons 	<ul style="list-style-type: none"> Conventionally armed but nuclear possible 	<ul style="list-style-type: none"> Conventionally armed
Approach	<ul style="list-style-type: none"> Revitalize Cold War-era platforms 	<ul style="list-style-type: none"> Develop novel platforms 	<ul style="list-style-type: none"> Revitalize A2/AD penetration weaponry
	<ul style="list-style-type: none"> Continuing previous Soviet R&D efforts 	<ul style="list-style-type: none"> Draws on unique PRC civil-military fusion complex 	<ul style="list-style-type: none"> Restarting earlier R&D efforts
Platforms	<ul style="list-style-type: none"> Intercontinental HGV Regional HCM and ALBM for global use (including against CONUS) 	<ul style="list-style-type: none"> Regional HGV and HCM for Indo-Pacific theater May pursue intercontinental HGV 	<ul style="list-style-type: none"> R&D of several HCM and HGV intermediate-range platforms; possible Intercontinental HGV
Challenges	<ul style="list-style-type: none"> Unknown operational capacity Limited global sensor network U.S. preemption 	<ul style="list-style-type: none"> Limited global sensor network Lack of wartime experience 	<ul style="list-style-type: none"> Fitful program priorities Uncertain missions Uncommitted allied basing
Arms Control	<ul style="list-style-type: none"> Some systems limited by New START Other limits possible with “equal security” 	<ul style="list-style-type: none"> Rejects trilateral format 	<ul style="list-style-type: none"> Under review
Exports	<ul style="list-style-type: none"> Already selling offensive and defensive systems 	<ul style="list-style-type: none"> Future exports possible 	<ul style="list-style-type: none"> R&D programs with allies

Table 1. Comparing Russian, Chinese, and U.S. Hypersonic Programs for 2021–2031 Period

POTENTIAL SINO-RUSSIAN COLLABORATION

Until now, there has been no overt cooperation between Russia and China regarding hypersonic weaponry. Their national R&D programs have been proceeding independently, while their joint arms control initiatives have not directly encompassed hypersonic issues. Even so, future Sino-Russian collaboration on hypersonic weapons is plausible given their extensive military and diplomatic cooperation in other security areas. For more than a decade, Russia and China have engaged in an extensive exercise program, both bilaterally and in a multilateral format. In the last few years, Moscow and Beijing have undertaken several bilateral counter-BMD exercises. They might extend these to cover hypersonic systems.

Furthermore, Russian and Chinese representatives have coordinated their arms control stances on several issues. For years, they have submitted joint drafts to the United Nations of a Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects, designed to hobble U.S. space and missile defenses while shielding their counterspace capabilities.²⁸ They have also

pushed a Sino-Russian peace plan for the Korean Peninsula to restrict U.S. military activities in South Korea.²⁹ In the future, they could extend their joint efforts to press for limits on U.S. hypersonic capabilities, while protecting their own systems. For example, Moscow and Beijing may propose prohibiting the deployment of ground-launched intermediate-range missiles, including hypersonic delivery systems, outside of national territories—effectively constraining U.S. but not Russian or Chinese capabilities.

Russia has sold the PLA substantial advanced military equipment during the past three decades, which has enhanced China's power projection and A2/AD capabilities in multiple dimensions, eroding U.S. military advantages. In October 2019, Putin surprisingly announced that Russia was helping the PRC develop a strategic missile early-warning system, one of its most sensitive military technologies. Over the next decade, the same considerations might lead to future Sino-Russian cooperation in researching, developing, or exchanging hypersonic technologies related to propulsion, sensors, or countermeasures. Since their hypersonic capabilities are different, Russia and China have an incentive to pool their efforts. Russia has more advanced intercontinental and missile defense systems, whereas the PRC has more intermediate-range HGVs and financial resources. Russia could piggyback on China's growing space program to develop a comprehensive early-warning and tracking system of U.S. hypersonic missiles. Russia and China have already integrated their GLONASS and BeiDou satellite navigation systems.³⁰ Alternatively, they could combine Russian interceptors with PRC space-based radars. Russia has also sold several batteries of its S-400 systems to China—and might sell the more advanced S-500s, which have greater capacity to intercept hypersonic delivery systems. Furthermore, PRC operatives might secure Russian hypersonic technologies through cyber theft or other unauthorized means.

POSSIBLE RUSSIAN-CHINESE PROLIFERATION TO OTHER ACTORS

Demand- and supply-side factors could facilitate the proliferation of hypersonic technologies to Iran, North Korea, and other potential U.S. adversaries. Iran and North Korea want hypersonic weaponry to deter and disrupt potential U.S. military operations against them. Both states are prioritizing investment in offensive and defensive missiles rather than warplanes. They also regularly showcase high-profile missile technologies to garner international attention. These two countries have robust missile research, development, and testing programs. Scholars at the University of Tehran have researched hypersonic technologies.³¹ In April 2021, the Kim Jong Un National Defense University established a new “hypersonic missile technology” college.³²

Several factors might lead Russia or China to transfer hypersonic capabilities to Iran or North Korea. For decades, Moscow and Beijing have been proliferating, through arms transfers to other states, A2/AD capabilities such as sea mines, anti-ship missiles, and air defense systems. These weapons can impede U.S. military operations against recipient countries. Russia and China also seek to increase arms sales to boost their economies and sustain influence with other states. Russia's state arms seller Rosoboronexport has started advertising hypersonic detection radars to foreign buyers.³³ The UN Security Council ban on major arms sales to Iran expired in 2020, while restrictions on defense and dual-use transfers to North Korea may slacken. Before the UN arms embargo, Russia and China sold missiles and other weapons to Iran. Moscow and Beijing also want to keep the United States preoccupied with an Iranian and North Korean threat rather than focus on strengthening defenses against Russia and China.

In April 2019, Lt. Gen. Samuel Greaves, Director of the U.S. Missile Defense Agency (MDA), told Congress that the risk of Russia's and China's hypersonic missile technology spreading to countries like Iran and North Korea was “extremely high ... I don't see what will prevent it from happening.”³⁴ Some factors that could induce Russian and PRC restraint include opposition by other countries, including in the Middle East and East Asia, as well as concern about the onward proliferation of these technologies to additional states. Furthermore, the complexity and expense of developing hypersonic weaponry also limit their potential proliferation.³⁵ Yet, even if Moscow

and Beijing do not deliberately provide hypersonic weapons to other countries, unauthorized proliferation of their hypersonic technologies could occur. Despite export restrictions, Iran and North Korea have continued to acquire Russian and Chinese defense dual-use technologies, perhaps through unauthorized transfers through third parties. For instance, the KN-23 missile North Korea tested in July 2019 resembles Russia's advanced Iskandar-M.³⁶ Given past collaboration between Iran and North Korea in ballistic missile R&D, their joint development of hypersonic capabilities is possible.³⁷ In any case, the costs and barriers for countries seeking hypersonic missiles will decline over time as hypersonic technologies become more available.

MITIGATING THESE CHALLENGES

The deployment of hypersonic missiles by Russia and China, as well as their possible hypersonic-related collaboration with each other and other potential U.S. adversaries, threaten strategic and crisis stability as well as regional U.S. deterrence missions. To mitigate these challenges, the United States can limit adversary hypersonic threats through arms control measures, regional defense enhancements, and comprehensive analysis of how hypersonic weapons affect escalation dynamics. Through its direct support of the CCMDs and other DoD elements as well as its sponsored research and studies, DTRA will make an important contribution to ensuring that the United States can realize its national security objectives notwithstanding these Russian and Chinese hypersonic-related activities and capabilities.

Strategic Arms Control Options

During the next decade, Russia and China, independently or perhaps through a combined proposal, will likely offer arms control proposals designed to constrain the hypersonic capabilities of the United States and its allies while protecting their systems. For example, they might propose a ban on stationing ground-launched hypersonic missiles outside of national territories to exclude U.S. land-based systems in Europe and Asia. The prospect of realizing a new treaty limiting only hypersonic weapons in the next few years is low. Moscow would likely demand major U.S. concessions for constraining, or subjecting to U.S. inspection, additional Russian hypersonic systems. Meanwhile, the PRC has refused to negotiate limits on any of its hypersonic systems. Any agreement would probably need to cover more than just hypersonic systems since the three countries will possess different types of these weapons. Additionally, Russian and Chinese officials seek these capabilities to counter non-hypersonic U.S. systems, such as missile defenses, rather than exclusively match U.S. hypersonic programs. Even so, even conventionally armed hypersonic systems, if able to destroy some targets that now require a nuclear warhead, could free up some Russian and PRC nuclear systems to attack other targets, effectively augmenting the Russian and Chinese strategic arsenals.

The U.S. government will respond to Russian and Chinese arms control proposals as well as offer its own. In coordination with the Office of the Secretary of Defense and other agencies, DTRA will advise the U.S. government on how various proposals to control nuclear-armed or dual-use hypersonic systems would promote or impede U.S. security objectives.³⁸ For instance, DTRA could assess whether to try to include certain Russian and Chinese hypersonic delivery systems under future agreements, whether to group them with other delivery systems, what counting rules to apply, and how to verify compliance. Furthermore, some partial limits might apply to air-, sea- or ground-launched hypersonic systems of a specified range, or to systems with nuclear or conventional payloads. The three countries might also consider measures to decrease the risks of inadvertent escalation of conflicts involving hypersonic weapons. Additionally, if the United States seeks only conventionally armed hypersonic delivery systems, the U.S. government may propose prohibiting all nuclear-armed hypersonic missiles. In this case, DTRA would assess what systems to include in this ban, what a suitable verification regime might include, and other requirements. DTRA could also help U.S. policymakers assess arms control tradeoffs,

such as the net costs and benefits of limiting U.S. capabilities in exchange for constraining Russian and Chinese hypersonic systems. A similar tradeoff would arise in weighing the relative importance of protecting U.S. offensive hypersonic options to deter Russia and China, versus reassuring Moscow and Beijing that the United States is not seeking a first-strike capacity against them by constraining U.S. offensive systems. For instance, some partial ceilings (for numbers, types, capabilities, or locations) could reduce fears of a disarming first strike.

In addition to treaties and legally binding accords, Russian, Chinese, and U.S. negotiators could pursue less formal executive agreements, informal parallel unilateral actions, and strengthening international norms of behavior regarding the use of nuclear-armed hypersonic weapons. For example, Russia, China, and the United States might at some point agree to a permanent or limited-duration moratorium on further flight tests of some or all types of hypersonic systems. Confidence-and-Security-Building Measures (CSBMs) among the three countries could aim to decrease incentives for nuclear escalation through reducing risks of miscalculation, removing first strike vulnerabilities, and other steps to decrease escalation risks. For instance, the CSBMs might encompass information-sharing on capabilities of planned hypersonic weapons or pre-notification of launches of long-range systems.³⁹ Additional initiatives to voluntarily increase mutual transparency absent formal treaties could include regular discussions of hypersonic issues in strategic stability dialogues, such as potentially identifying means to avoid dangerous operational practices. In February 2021, the Russian Ambassador to the United States, Anatoly Antonov, said that Moscow was interested in pursuing wide-ranging discussions on new military technologies and other factors affecting the “security equation” between Russia and the United States.⁴⁰

In support of DoD’s role in ensuring compliance with WMD treaties and agreements, DTRA would assist with monitoring and verifying any new arms control accord negotiated and ratified by the United States that encompasses hypersonic capabilities. Some possible treaties and CSBMs could require differentiating conventional from nuclear-armed hypersonic weapons, which could involve on-site inspections in addition to other forms of multinational and national monitoring to include nuclear warheads as well as their means of delivery. Even without new treaties or CSBMs, DTRA will play a role in ensuring Moscow’s compliance with New START, recently extended to 2026. On November 26, 2019, the Russian government allowed U.S. observers to inspect an Avangard platform, in compliance with the Treaty. DTRA will therefore report on all Russian hypersonic weapon activities that it believes should be captured under New START, for which the United States has a right to a demonstration observation before deployment and then on-site inspections afterward. Additionally, DTRA would support any U.S. decision to exercise Article V of the Treaty regarding Russia’s hypersonic activities.⁴¹

Through its sponsored studies, DTRA can help clarify what systems could qualify as “hypersonic” under arms control treaties and agreements. Many delivery vehicles commonly termed “hypersonic” do not fly above Mach 5 for their entire flight. Meanwhile, long-existing intercontinental ballistic missiles and Submarine-Launched Ballistic Missiles fly faster than Mach 5 for much of their trajectories. This definitional ambiguity may increase as countries develop additional types of delivery vehicles and launching platforms, some mobile and dual-capable, to complicate adversary defenses.

Regional Defense Enhancements

Of the regional commands, most of DTRA’s activities will probably support the U.S. European Command (USEUCOM), the U.S. Indo-Pacific Command (USINDOPACOM), and USNORTHCOM. For the functional commands supporting the regional CCMDs, DTRA will most collaborate with U.S. Space Command (USSPACECOM) and U.S. Strategic Command (USSTRATCOM) as well as related DoD elements, such as the MDA. In coordination with the Office of the Secretary of Defense and the Joint Chiefs of Staff, DTRA could also provide

a means for cross-linking these regional and functional issues, such as working with USSTRATCOM to assess how different arms control regimes would apply to different geographic regions.

DTRA's contributions to USEUCOM will invariably encompass monitoring and responding to Russia's regional hypersonic developments and programs. Though Russian representatives deny that they have an "escalate-to-deescalate" doctrine, nuclear-armed hypersonic weapons could provide another means for Moscow to exploit Western fears of Russian escalation from conventional to nuclear warfare in a conflict. For example, Moscow might launch a nuclear-capable hypersonic missile during a conventional conflict in Europe to underscore the risks that a continuation of the conflict could escalate to the employment of nuclear weapons. Addressing the hypersonic threat from China, whose hypersonic activities remain focused on Asia, as well as possibly Iran and North Korea, which is primarily a non-proliferation and export-control issue, will likely remain of secondary importance for USEUCOM during the next decade. Due to the importance of the North Atlantic Treaty Organization (NATO), many of DTRA's Europe-focused activities will occur within an alliance framework.

The area of responsibility (AOR) of the USINDOPACOM, which includes the U.S. territory of Guam and the U.S. state of Hawaii, is most threatened by China's regional hypersonic capabilities. The PLA is developing several new HGVs and HCMs to supplement its already formidable portfolio of intermediate-range strike platforms. Nonetheless, USINDOPACOM must also consider Russian hypersonic activities in its region. Russia keeps a substantial military force in northeast Asia. In addition, hypersonic vehicles anywhere in Russia could rapidly redeploy within range of the USINDOPACOM AOR. Furthermore, Russia may support the hypersonic development programs of China, North Korea, and perhaps other Asian states. USINDOPACOM has a weaker supporting network of allies and partners than USEUCOM. Since USINDOPACOM's cooperative programs and activities with Asian countries are primarily bilateral, with some smaller and looser multinational coalitions, many of DTRA's supporting activities will focus on individual U.S. Asian allies and partners.

USNORTHCOM, supported by USSPACECOM, will be responsible for defending the North American theater from hypersonic threats. Russia's intercontinental-range delivery systems, its HCMs on naval platforms patrolling near the U.S. coasts, and the ALBMs on Russian MiG-31s operating from bases in the Arctic currently threaten CONUS. In the next few years, the PRC could deploy dual-capable delivery vehicles capable of directly threatening North America as well. Both countries may seek non-nuclear means of strategic attack on the U.S. homeland, expecting they could strike CONUS targets without triggering U.S. nuclear retaliation. Unlike the long-standing challenge from Russia's strategic missiles and bombers, the speed, maneuverability, and unpredictable approach vectors of hypersonic systems could present novel threats to North America.⁴² USNORTHCOM and North American Aerospace Defense Command may request DTRA's assistance in modeling these new threats to the U.S. homeland. DTRA could also help other DoD elements that request aid in developing options and capabilities for the national hypersonic defenses of CONUS, as the U.S. government debates how to address this threat. For example, the MDA, the lead DoD agency for U.S. hypersonic defense efforts, as well as the U.S. Defense Advanced Research Projects Agency, the Space Development Agency, and the U.S. Air Force might seek assistance researching improved space-based early-warning sensors against hypersonic missile strikes.

Hypersonic issues may become more important for U.S. Central Command if Russia deploys such systems in its AOR or if Iran, Israel, and other states pursue these capabilities. Conversely, for the U.S. African Command and U.S. Southern Command, hypersonic issues will be of lower importance for the next decade unless Russia, China, or some other country decides to deploy or employ hypersonic weapons in Africa or South America or sell them to a regional partner. Still, U.S. regionally deployed forces in any CCMD's AOR may bring conventionally armed hypersonic weapons to the theater or draw on hypersonic capabilities based elsewhere.

As requested, DTRA could help each regional CCMDs with threat assessments, requirements generation, contingency planning, and mitigation measures regarding Russian and Chinese hypersonic systems. A specific concern of some regional CCMDs is reducing the vulnerability of U.S. forward-based forces and facilities to

Russian and Chinese hypersonic missiles. CCMDs are considering passive measures such as redundancy, deception, mobility, concealment, hardening, redundancy, dispersal, recovery and reconstitution.⁴³ For example, the U.S. Air Force is developing the Agile Combat Employment concept to disperse U.S. warplanes to deny the PLA aggregated strike targets.⁴⁴ The U.S. Army's new strategy also relies on concealment, camouflage, dispersal, and other means to negate concentrated PLA strikes.⁴⁵ Some of these measures could reduce U.S. flexibility, response time, and other defense capabilities. More active defenses against Russian and Chinese hypersonic delivery systems might include disrupting targeting data, novel BMD interceptors, and space-based sensors for "birth-to-death tracking," for which USSPACECOM might take the lead.⁴⁶ DTRA can help the CCMDs and Services model how these measures in combination could most mitigate Russian and Chinese hypersonic threats, especially from nuclear-capable delivery systems.

Other non-DTRA DoD elements should consider measures to ensure the security of U.S. and allied hypersonic systems from cyber attacks as well as evaluate the potential for U.S. cyber capabilities to hack adversary hypersonic networks, including means to alter the course of missiles after launch. Another issue for consideration by DoD policymakers is assessing the impact of allied interoperability gaps resulting from the more rapid U.S. acquisition of hypersonic technologies.⁴⁷ Furthermore, U.S. regional CCMDs must prepare for contingencies involving Russian and Chinese hypersonic capabilities simultaneously. Existing defense planning scenarios may not adequately address how Russia or China could exploit conflicts between the other and Washington to advance their own security interests while the United States is preoccupied elsewhere.⁴⁸ U.S. and allied intelligence agencies should constantly assess Sino-Russian hypersonic interactions, sharing that data with DTRA and the CCMDs, to avert technical and strategic surprises.

Additionally, DTRA can help the CCMDs with their planning for contingencies involving the operational use of hypersonic weapons by developing virtual "playbooks" for how to respond under various scenarios. Drawing on DTRA's modeling, simulation, and studies, these computer programs could allow users less familiar with hypersonic weaponry to consider their full range of possible WMD effects and implications. DTRA can also help with any upgrade to the U.S. and allied early-warning and command-and-control systems to counter hypersonic threats, which typically require more rapid threat assessments and decision-making responses. Robust joint experimentation and exercise programs could help CCMDs mitigate potential command-and-control conflicts, seams, and other issues due to these conditions.⁴⁹ DTRA should also regularly invite representatives of relevant CCMDs in any Track I.5 dialogues addressing hypersonic issues. While focusing on countering Russian and PRC hypersonic delivery systems, DTRA could assist CCMDs requesting assistance with developing and exercising scenarios involving possible Iranian and DPRK hypersonic missiles. The NDS and the 2021 Interim National Security Strategic Guidance identify these Iran and North Korea as major state threats to the United States, along with Russia and China.⁵⁰

Cross-cutting Operational Issues

Through its analysis and supported studies, DTRA can help optimize U.S. responses to issues that encompass both global strategic questions and regional operational issues. For example, in both areas, the United States and its allies will need timely monitoring and assessment of the hypersonic-related research, development, and testing programs of Russia, China, and other foreign adversaries, such as Iran and North Korea. Research and developments in this field have expanded rapidly during the past few years. They could accelerate with the entry of these systems into operational use. Expert surveys can help DTRA and other U.S. government agencies keep abreast of the relevant open-source publications, including data posted on social media. DTRA will also need to work closely with the U.S. intelligence community to evaluate this data since some important information may not be publicly accessible. For instance, the PLA is conducting missile exercises "virtually" through computer simulations, resulting in less-visible drills accessible to open-source analysts.⁵¹

Russian and Chinese hypersonic R&D is occurring in a context in which other military technologies are also intensifying surprise, increasing lethality, compressing decision-making time, straining existing command-and-control structures, and altering warfighting and escalation dynamics. These technologies include the proliferation of counterspace, cyber, autonomous weapons, and artificial intelligence capabilities. Through their interconnected dynamics, these developments could combine in unpredictable ways to exacerbate arms racing pressures, increase instability during a crisis, and generate unexpected escalation pathways under some scenarios.⁵²

DTRA-supported studies could also address possible options for enhanced multinational export controls by the United States and its partners to deny adversaries Western military and dual-use goods and technologies that could contribute to their hypersonic capabilities.⁵³ The PRC hypersonic program has benefitted from such imported U.S. technologies.⁵⁴ Conversely, U.S. officials might call upon DTRA expertise to aid in any U.S. hypersonic-related export negotiations involving Russia, China, and other countries. As they have with some other missile-related technologies, Moscow and Beijing might decide to collaborate with the United States and other countries to limit the proliferation of hypersonic weapons to certain other state or non-state actors. Since Russia and China do not want Japan, South Korea, or Taiwan to obtain hypersonic strike systems, they have incentives to work with Washington to limit their spread. However, DTRA could help U.S. officials assess the net costs and benefits of agreeing to limit U.S. cooperation with allies and partners on hypersonic issues in exchange for Moscow and Beijing constraining their collaboration with other countries.⁵⁵ DTRA expertise would also help U.S. policymakers consider whether and how to combine vertical and horizontal limits on Russian, Chinese, and U.S. hypersonic-related activities. The Nuclear Non-Proliferation Treaty entails such a vertical-horizontal package. Another issue for study might be whether to employ the Missile Technology Control Regime to limit sales of hypersonic weaponry. Though Russia is a member of these agreements, the PRC is not; yet, China has committed to follow the guidelines of these missile export regimes.⁵⁶

In collaboration with U.S. Strategic Command (USSTRATCOM) and other DoD elements, DTRA research and supported studies could help inform debates on U.S. defensive and offensive options against Russian and Chinese hypersonic threats. For example, fielding hypersonic delivery vehicles capable of attacking Russian and Chinese territory could enable the United States to:

- limit damage from Russian and Chinese strike systems;
- enhance deterrence of Russian and Chinese policymakers;
- reassure threatened U.S. allies and partners;
- influence perceptions (i.e., avoid the appearance of a “hypersonic gap” with Moscow and Beijing); or
- provide arms control leverage for negotiations with Moscow and Beijing.

Regarding the latter, Russia and China might limit their hypersonic delivery vehicles to prevent U.S. offensive hypersonic missiles from substantially devaluing their integrated air-and-missile defenses. The United States might also pursue hypersonic systems to penetrate Russian and Chinese A2/AD bubbles and to eliminate Russian and Chinese road-mobile missiles before they change locations.⁵⁷ Yet, some U.S. offensive operations could generate escalation dynamics and worsen crisis stability. For example, due to the conventional-nuclear integration of some command, control, and other hypersonic-related assets in the United States, Russia, and China, a hypersonic strike against a conventional target could also degrade a country’s nuclear deterrent, which could generate inadvertent escalation dynamics. DTRA can help assess these tradeoffs regarding what offensive hypersonic missiles the United States should deploy, where to base them, how to employ them, and what measures could reduce their vulnerability to preemption, while supporting U.S. arms control objectives.

KEY FINDINGS AND RECOMMENDATIONS

- **Finding:** In terms of strategic deterrence, hypersonic delivery systems could provide Moscow and Beijing with novel means to attack the U.S. homeland. Russian and Chinese policymakers seek this capacity to make their threats of retaliation for U.S. military actions against them more credible. They perceive hypersonic weapons as helping them deter the United States from aiding countries threatened by Russian and PRC coercion.
- **Recommendation:** DTRA should jointly assess with USNORTHCOM and NORAD the evolving Russian and Chinese threats to North America from hypersonic delivery systems. These threats could encompass intercontinental-range missiles launched from Russian and Chinese territory and intermediate-range systems delivered by air and naval platforms operating near CONUS. DTRA should assist as requested in developing options and capabilities for U.S. national defense, including enhanced space-based tracking, as well as offensive capabilities against these hypersonic threats.
- **Finding:** At the regional level, Russian and Chinese theater-range hypersonic delivery systems present additional threats to U.S. forces, facilities, and allies, especially in Europe and Asia. These weapons further impede U.S. regional power projection and decrease U.S. military advantages. By amplifying the most threatening dimensions of Moscow's and Beijing's regional political-military coercive strategies, Russian and Chinese hypersonic systems could weaken the credibility of U.S. security guarantees. Moreover, they could adversely affect crisis stability and escalation dynamics by making Moscow and Beijing more confident about using military force.
Recommendation: DTRA should help CCMDs assess how to reduce the growing vulnerability of forward-based U.S. forces and facilities to Russian and Chinese hypersonic weapons. DTRA should also assist DoD components with modeling, simulation, and exercises involving Russian and Chinese hypersonic threats to support regionally tailored threat assessments, requirements generation, and contingency planning. DTRA activities could provide means to cross-link regional and functional issues, such as evaluating how different hypersonic technologies or arms control regimes would apply in different geographic regions.
- **Finding:** Russia and China are pursuing a similarly broad portfolio of hypersonic systems, including HGVs and HCMs of varying ranges, for multiple roles and contingencies. Both states seek such asymmetric capabilities to deter and defeat U.S. military forces. Nonetheless, important Sino-Russia divergences are visible. Russia still prioritizes strategic nuclear deterrence and hypersonic defense more than China. Furthermore, only Russia is now threatening CONUS with hypersonic weapons and overtly arming hypersonic delivery systems with nuclear warheads. In recent years, however, China has launched a well-resourced

hypersonic R&D program to complement its uniquely large number of intermediate-range missiles.

- **Recommendation:** Tailored DTRA support to CCMDs should reflect the diverging military-industrial structures, political-military strategies, and regional security environments shaping the Russian and Chinese hypersonic threats in each theater. The Agency could help DoD-wide planning for hypersonic-related contingencies address these Sino-Russian similarities and differences.
- **Finding:** Though the Russian and Chinese hypersonic research, development, and deployment programs have proceeded independently, potential Sino-Russian hypersonic collaboration could encompass joint arms control initiatives, binational exercises, and defense industrial collaboration. Russia and China could try to constrain U.S. hypersonic activities through various arms control proposals, extend their joint exercises to include hypersonic missions, and pursue some joint R&D projects.
- **Recommendation:** DTRA should hedge against these possible Sino-Russian hypersonic interactions and help evaluate those that occur. In particular, the Agency should proactively anticipate what arms control proposals Moscow and Beijing might offer. These may encompass legally binding ceilings as well as less formal transparency and confidence-building measures. If requested, DTRA can proactively help the U.S. government develop hypersonic arms control proposals. DTRA will assist with monitoring and verifying Russia's intercontinental Avangard HGV under New START and additional systems covered by any new arms control agreements.
- **Finding:** Iran and North Korea may acquire Russian or Chinese hypersonic technologies during the next decade. Even if Moscow and Beijing continue to restrict exports of their most advanced military systems to Iran and North Korea, Tehran and Pyongyang will likely vigorously pursue various channels, including illicit means, to acquire Russian and Chinese hypersonic technologies.
- **Recommendation:** DTRA should assist CCMDs to develop options and rehearse responses to hedge against the possible acquisition of hypersonic weapons by Iran and North Korea. As requested, DTRA should advise U.S. policymakers on possible sanctions, export controls, mutual restraint arrangements, and other measures to prevent hypersonic weapons proliferation to potential U.S. adversaries.

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APPENDIX A – LIST OF ACRONYMS

A2/AD	Anti-Access/Area Denial
AI	Artificial Intelligence
AOR	Area of Responsibility
ALBM	Air-Launched Ballistic Missile
BMD	Ballistic Missile Defense
CCMD	U.S. Combatant Command
CONUS	Continental United States
CSBM	Confidence-and-Security-Building Measures
DoD	U.S. Department of Defense
HCMs	Hypersonic Cruise Missiles
HGV	Hypersonic Glide Vehicle
INF	Intermediate-Range Nuclear Forces
MDA	Missile Defense Agency
NATO	North Atlantic Treaty Organization
NDS	U.S. National Defense Strategy
PLA	Chinese People's Liberation Army
PRC	People's Republic of China
R&D	Research and Development
USEUCOM	United States European Command
USINDOPACOM	United States Indo-Pacific Command
USNORTHCOM	United States Northern Command
USSPACECOM	United States Space Command
USSTRATCOM	United States Strategic Command
WMD	Weapons of Mass Destruction

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