Conventional Guided Missiles in Russian and Chinese Active Defence

Jonathan Holslag

In May 2018, Russia reported that a new air-defence system destroyed a target that was almost 500 kilometres away and claimed that its radar could detect both advanced stealth aircraft and incoming ballistic missiles. In the summer of 2019, China said it destroyed a moving target in the South China Sea with two ballistic missiles. The test sent a strong signal to the United States and its partners. The traditional dominance of their aircraft carriers and warships was about to come to an end. The warheads of such ballistic missiles approach their targets much faster than most anti-ship missiles that fly low over the water. Both tests are examples of Russia and China's desire to overcome adversaries well beyond their borders.

This paper reviews the role of conventional guided missiles in this pursuit: tactical ballistic missiles, land-attack cruise missiles, anti-ship missiles, and air defence missiles. Chinese and Russian military modernization is broad, encompassing everything from the infantry platoon to super-heavy intercontinental ballistic missiles. But guided missiles expand the options for conflict escalation. Especially when launched from trucks on land, they are cheap and difficult to counter. That is perhaps the main advantage of the two continental powers today. If their main adversary, the United States, relies on expensive platforms, China and Russia can use the full strategic depth of their territory and develop diffuse networks of missiles and sensors.

The debate about conventional missile systems is relevant in the larger discussion about geopolitics. Across the land mass, regional powers seek to extend their sphere of influence and to keep military rivals at a distance. Friction between Eurasia's continental giants and maritime powers is a returning theme in the history of world politics. Each era comes with new defence systems: from Vauban's coastal battery fortresses over Adolf Hitler's Atlantic wall, to Admiral Gorshkov's vision of saturation attacks against "enemy ground objectives and the protection of one's territory from the strikes of his fleet."[1] Today, experts speak of anti-access and area-denial, or A2AD, an effort, primarily of Russia and China to respond to American dominance along the maritime fringes of Eurasia.

The geopolitical dilemma is straightforward. To enhance their freedom of manoeuvre in an extended sphere of interest; Beijing and Moscow need to limit America's. In its most defensive form, this pursuit is about regime security and territorial sovereignty. Less defensively, it is about enforcing claims in contested areas and to achieve regional dominance, which can give way to broader power projection. If the United States were to lose its freedom of action and its military advantage around the Eurasian landmass, the two continental powers would be unchecked. Power unchecked incites assertiveness and arrogance.[2] The preservation of a balance between maritime and continental power projection, is thus important for the security in Eurasia and beyond.

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[1] Teslenko, Oleg, 2000. возврат судной артиллерии. The Return of Naval Artillery. October 2000.
[2] Campbell, Kurt and Rush Doshi, 2021. How America Can Shore Up Asian Order. *Foreign Affairs,* January 2021; Mearsheimer, 2019. Bound to Fail. *International Security*. 43, 4.

While there exist many detailed studies about individual weapon systems, this paper offers a wide-ranging review of Russia and China's evolving guided missile capabilities. It builds on existing literature and complements it with insights from Chinese and Russian sources. The first part of the paper explains the relevance of guided missiles in light of China and Russia's vision of active defence. The next four chapters discuss three categories of missiles, yet start with an evaluation of the capacity to detect targets with surveillance radars.

Active defence

A2AD is a Western concept, coined in the early 2000s.[3] It captures the endeavour of countries like China and Russia to destroy enemy ships and aircraft, and to deter and defeat enemy presence in their vicinity. Specific about this stage of Eurasian military pushback, is the use of advanced weapons with a longer range and greater accuracy. A2AD is a continuation of a century-old phenomenon with new technological possibilities. The idea of denying adversaries access to a sphere of interest bears resemblance to the Chinese and Russian notion of active defence. But that concept is also fluid. On the one hand, it holds that threats need to be engaged before they reach the border. But the horizon of engagement has expanded throughout the last decades. On the other hand, it implies pre-emption and initiative. But what exactly needs to be pre-empted, ranges from threats against sovereignty to obstructions against the advancing of core national interests.

Active defence aims at military strike capacity in an extended neighbourhood. It implies thus a sphere of military dominance. In modern China, it has its origin in the transformation of Mao Zedong's civil war mode of deep defence, into the involvement of the juvenile People's Republic into the Korean War, a brief border war with India in 1962, and the invasion of Vietnam in 1979. After the Gulf War, active defence was combined with limited war under high-tech conditions. This entails a focus on countering weapon systems such as cruise missiles launched from ships, stealth bombers, and so forth.

A useful starting point for analysing what contemporary active defence means, is where the Soviet Union left it at its collapse. The Soviets had a broad vision of winning small wars in their vicinity, to destroy forward bases, to interdict access to sea lines of communication, and to go after naval platforms that could launch long range missiles. As all that happened under the spectre of nuclear retaliation, conventional active defence was about increasing the range of options for escalation. China too had such a vision, but had much less capabilities at that time. Xiao Jingguang, for instance, wrote about offensive saturation campaigns, to annihilate, weaken, deplete, tire out, and divide the enemy." Liu Huaqing developed on this vision, with his famous island-chain-based spheres of military domination and much more emphasis on missiles.

Active defence today shows both qualitative and quantitative changes. China has immensely increased its mass manoeuvre capacity, by means of world class transport infrastructure, large numbers of landing-ships, aircraft, potent light armoured vehicles, and, much better trained soldiers. Russia follows, but more modestly. Second, both China and Russia possess increasingly advanced early warning and surveillance, which help diminish the freedom of manoeuvre of other countries' high-value platforms, including submarines and stealth aircraft. Third, China and Russia expand and modernize their theatre ballistic, air defence,

[3] Andrew Krepinevich, Barry Watts, and Robert Work, 2003. *Meeting the Anti-Access and Area Denial Challenge.* Washington D.C.: CSBA.

anti-ship, and land attack cruise missile strike capacity. While missiles are only a part of Russian and Chinese active defence, their large number, scattered over a large surface of land, their ongoing modernization, and the attempt to deploy them "networked" is creating a unique capacity that could alter the military balance further.

Missiles in active defence

But what role do guided missiles play in Chinese and Russian active defence? Russian and Chinese active defence is broad and comprehensive. It does not count on a single assassin's mace, but a combination of several advanced weapon systems, and, most of all, the readiness to use overwhelming force and large numbers of troops.[4] "At the end of the day, war in the Asia-Pacific will be about hundreds of thousands of PLA soldiers dashing into Taiwan and ready to sacrifice," a Chinese officer put it, "Planes, missiles and other weapons are important, but the key is whether you are ready to fight. I don't think the West is ready to fight."[5] Technology is an enabler for large-scale manoeuvres, invasion forces, and so forth.[6] This is the case of China and its visions for a war over Taiwan, but also has been demonstrated in recent Russian campaigns in the Caucasus and various large exercises. It is not just about stopping adversaries, but about advancing, getting boots on the ground in contested areas, and to do so with the intention to stay. Missiles, electronic warfare, and many of the other high-tech systems are innovative enablers for time-tested endeavours of gaining ground - and holding it. Guided missiles remain enablers. "Contactless wars," the Russian Ministry of Defence posited, "do not exist." [7]

Let us now review the use of missiles in Chinese and Russian active defence more into detail. Two sets of open sources allow us to attempt to answer that question. On the one hand, there are various public military writings that give a broad impression of how the two countries expect to fight. In case of China, these include important volumes such as the *Science of Military Strategy* (2013), and the *Science of Campaigns*, and *Science of Second Artillery Campaigns*. In case of Russia, we cannot possibly sidestep recent views of Chief of Staff Gerasimov, as well as some authoritative studies by senior Russian military officers, including Missile Forces Commander Vladimir Zaritsky's essays and Chekinov and Bogdanov's review of Russian military sources on new generation war. Another source concerns recent missile exercises.

Military and civilian high-value targets. In both countries, conventional guided missiles' primary advantage is that they can destroy high-value land-based assets at the beginning of a campaign, such as parts of the command and control chains, sensors, and air bases, but also civilian targets including railway nodes, energy facilities, and ports.[8] The Chinese armed forces envision the use of conventional missiles against "strategic and theatre command centres, communication systems, radars, and other information targets, missile systems, air bases, naval bases and targets like campaign air fields, railway stations, bridges, large army

[4] For instance: Xiong Yuxiang and Niu Yujun, 2019. 坚持积极防御战略思想, 丰富完善时代内涵 Persist in the strategic thinking of active defense, perfect the connotation of our times. 1 October 2019
[5] Conversation with Chinese senior PLA officer, Brussels, 20 June 2013.
[6] Zhang, Yuliang, chief ed. 2006. 战役学, *Science of Campaigns.* Beijing: National Defence University Press, p. 629.
[7] Russian Ministry of Defence, 2003. Current Tasks of the Development of the Russian Armed Forces. Актуальные задачи развития Вооруженных Сил Российской Федерации. Moscow: MOD, § 4.9.
[8] For instance: Ling, Shengyin, Zhou Min, and Sun Ying, 2017. 毫不动摇地坚持积极防御战略思想, Unswervingly adhere to the strategic thinking of active defense. *People's Daily,* 19 April 2017: "spike kill" 秒杀.

groups, logistical hubs, energy facilities."[9] In this regard, they are called limited offensive weapons (在內的有限進攻性武器).[10]

A powerful expression is a testing site of the PLA Rocket Forces in the West of Gansu Province, where around 2013 a mock-up of a navy base and landing strip was built. Satellite images show impacts of ballistic missile sub-munitions and penetrating warheads in hardened shelters. Seven years before, another mock-up of a Taiwanese air base was built in this area, showing impact blasts from two warheads from around 2006-07.

Image 1. Rocket Force Test Site (40°28'48.01"N 93°28'55.42"E). *Source*: Maxar, 2013.

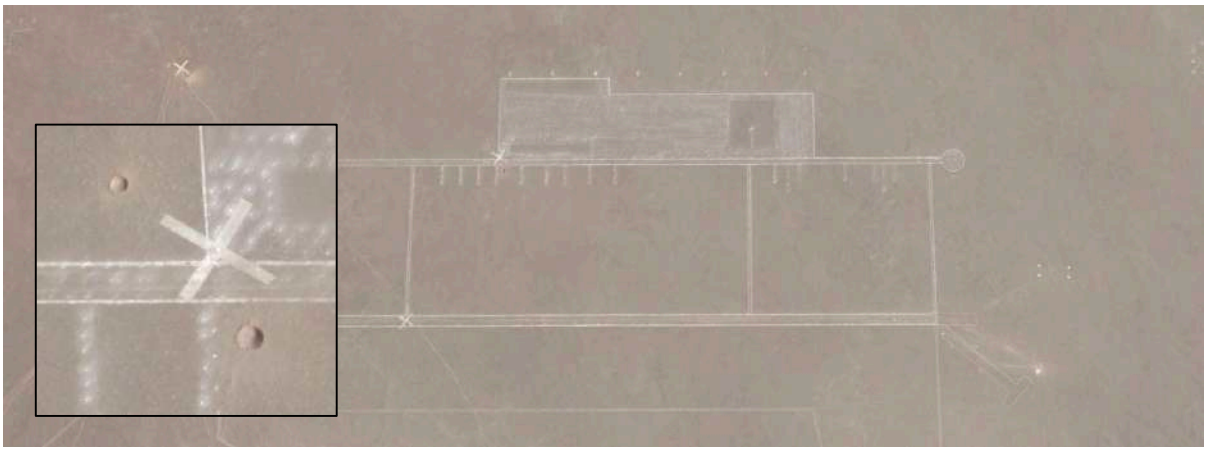

Image 1. Rocket Force Test Site (40°22'9.02"N 99°51'1.94"E). *Source*: Maxar, 2006.

Initiative, pre-emption, and surprise. Russia and China consider conventional guided missiles important to seize the initiative, to surprise, and to prevent the enemy from getting itself organized. In the case of Russia, active defence is a continuation of the multi-layered vision of defence and counterstrike of the Soviet Union. "Troops will be able to inflict

[9] Yu, Yixun and Li Tilin, eds. 2004. 第二炮兵战役学, Science of Second artillery Campains. Beijing: PLA Press, p. 318

[10] Wang Zhangqin and Fang Guangming, 2015. 中國為啥研東風 26？ Why does China need to develop the Dong Feng 26? People's Daily, 23 November 2015

significant defeat on the enemy with long range fire long before direct contact."[11] Gerasimov adds: "Acting quickly, we must pre-empt the enemy with our preventive measures, timely identify its vulnerabilities, and create a threat of unacceptable damage to him."[12] Chinese strategists observed that the detect-locate-strike-time has diminished from 100 minutes in the Gulf War, to 40 minutes in the Kosovo War, to below 10 minutes today. Hence, they conclude, it is vital "to disturb the adversary's operational pace and … to firmly grasp the time initiative."[13]

Deep and broad. A third feature is that missiles help engage the enemy across a wide and deep theatre. Remarks Zaritsky: "Nowadays, the trend is towards a significant increase of the depth of the instant destruction of enemy troops, the preventive strikes, and to inflict damage in depth."[14] In this regard, Zaritsky also highlights the need for deep reconnaissance. Chekinov and Bogdanov speak of "striking adversary targets in all areas and along the full depth and width of his territory."[15] Chinese sources underscore the importance of missiles in integrated intermediate-range precision or stand-off strikes, and to strike strategic targets along the full depth of the theatre.[16] The Science of Second Artillery and the Science of Military Strategy both put a lot of emphasis on the fact that broad and deep defence requires the missile units to be well-integrated in theatre commands.

Saturation and precision. A fourth characteristic is that they combine saturation with precise strikes. Zaritsky put it thus: "In an initial stage, the (missile forces) participate in massive and concerted blows; in a second occasion, they focus on multiple single strikes… to have constant impact."[17] Chinese strategists speak of the importance to render the enemy "unable to see, unable to hear clearly, unable to connect" through incessant follow-up strikes.[18] *Science of Campaigns* advises saturation attacks (饱和攻击) from multiple directions and to use massive and concentrated conventional missile deployment against limited targets.[19]

Attrition. A fifth element is the use of guided missiles to wear out the enemy, by inflicting damage to both civilian and military targets, and to destroy its morale. "Intensive strikes against centres of national and military power, as well defence-industrial targets… will undermine the capacity of the adversary's troops and population to resist."[20] Chinese sources specify: "[Conventional missile strikes] not only destroy or weaken the enemy's military

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[11] Russian Ministry of Defence, 2003. Op. cit, § 4.5.
[12] Gerasimov, Valery, 2019. Векторы развития военной стратегии. Vectors of Military Strategy Development. Speech at the Academy of Military Sciences, 3 April 2019
[13] Shou, Xiaosong, ed., 2013. 战略学, *Science of Military Strategy* 2013. Beijing: Military Science Press, p. 96.
[14] Zaritsky, Vladimir, 2006. Направления совершенствования форм и способов боевого применения РВиА в общевойсковой операции. Areas of improving the forms and methods of combat use of MFA in a combined-arms operation. *Military Thought*, 11, p. 12.
[15] Chekinov, Sergei and Sergey Bogdanov, 2013. О характере и содержании войны нового поколения. On the Nature and Content of New Generation War. *Military Thought*, 10, p. 21.
[16] Shou, Xiaosong, ed., 2013. Op. Cit. p. 93, 229; Zhang, Yuliang, chief ed. 2006. Op. cit., p. 629.
[17] Zaritsky, Vladimir, 2006. Направления совершенствования форм и способов боевого применения РВиА в общевойсковой операции. Areas of improving the forms and methods of combat use of MFA in a combined-arms operation. *Military Thought*, 11, p. 12.
[18] Shou, Xiaosong, ed., 2013. Op. Cit. p. 95.
[19] Zhang, Yuliang, chief ed. 2006. Op cit. p. 302, 631
[20] Chekinov, Sergei and Sergey Bogdanov, 2013. О характере и содержании войны нового поколения. On the Nature and Content of New Generation War. Military Thought, 10, p. 12.

power… they also afflict the enemy's psyche and his will to fight."[21] Conventional missiles striking ground targets also inflict large psychological pressure on adversaries.[22]

Broadening deterrence and escalation options. Both China and Russia see missile attacks as an important step in broadening the escalation options below the nuclear threshold. One Russian paper speaks of non-nuclear deterrence. It advances a three-tier concept of deterrence, with intercontinental nuclear missiles as the first their; regional nuclear and non-nuclear deterrence as a second tier; and local non-nuclear as a third tier. "Strategic non-nuclear capabilities are viewed as a flexible instrument of countering threats, including local non-nuclear threats to the military security of Russia and its allies."[23] Chinese sources refer to an integrated whole-deterrence capability.[24] The Chinese Science of Military Strategy mentions the conventionalization of deterrence.[25] What remains unaddressed in most papers, however, is that the blurring between tactical and strategic, conventional and nuclear might in the end not only increase the options below the nuclear threshold, but also lower the nuclear threshold, as the ambiguity could prompt countries to adjust their nuclear strike trigger alert.

Dispersion and multi-dimension strike. Both countries are aware of the fact that missile launchers and their sensors are vulnerable, but that the immensity of their territory could allow for dispersion and creating strategic depth. The Russian chief of staff stated: "Mobile ground missile systems have all the necessary advantages of blending in a large area and to launch from an unexpected position. Military science needs to develop and specify a system of complex enemy destruction."[26] Chinese sources often underline the importance of radiation and multi-dimension strike (多维打击): "The inner land theatres conduct the necessary radiation and extension to outside the border while the coastal theatres expand and extend to the oceanic direction."[27]

Breaking maritime preponderance. If the missiles render land-based facilities in the neighbourhood vulnerable, it still leaves Russia and China exposed to standoff attacks from destroyers, attack submarines, and aircraft carriers.[28] Active defence, hence, comes with growing interest in using missiles against ships.[29] While the range and survivability of traditional subsonic anti-ship missiles is limited, a combination of supersonic short- to medium range anti-ship ballistic missiles and anti-ship ("cruise") missiles can target surface ships. China's Science of Campaigns speaks of closely coordinated naval, airborne, and land-based "missile attacks and harassment attacks" against ships and to use missile for naval blockades.[30] This was also asserted in the Science of Second Artillery Campaigns.[31] The main

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[21] Zhang, Yuliang, chief ed. 2006. Op cit. p. 719.
[22] Zhao, Xijun, 2005. 摄战, *Intimidation War*. Beijing, China: PLA Press, p. 244.
[23] Serlin Andrey et al. 2019, Современные трансформации концепций и систем вооружений в стратегическом сдерживании, Modern Transformations of Concept and Weapons Systems in Strategic Containment. *Military Thought*, 8, p. 16.
[24] Shou, Xiaosong, ed., 2013. Op. cit., 141, 231-233
[25] Shou, Xiaosong, ed., 2013. Op. cit., p. 228.
[26] Gerasimov, Valery, 2019. Векторы развития военной стратегии. Vectors of Military Strategy Development. Speech at the Academy of Military Sciences, 3 April 2019
[27] Shou, Xiaosong, ed., 2013. Op. cit. p. 106, 108.
[28] Garberg Bredesen, Maren and Karsten Friis Missiles, 2020. Vessels and Active Defence What Potential Threat Do the Russian Armed Forces Represent? *The RUSI Journal*, October 2020.
[29] Yu,Yixun and Li Tilin, eds. 2004. 第二炮兵战役学, Science of Second artillery Campaigns. Beijing: PLA Press, p. 318
[30] Zhang, Yuliang, ed, 2006.战役学, Science of Campaigns. Beijing: National Defense University Press, 140, 320.
[31] Ibid., pp. 140, 320–2

focus in the latter document is on carrier battle groups. To control the sea from the land(以陆制海) remains prominent in Chinese thinking.[32] Various publications testify of precise saturation attacks (导弹饱和攻击) against naval forces, or multi-direction saturation attacks (多向导弹饱和攻).[33]

We see anti-ship missile attacks being tested in the Gansu Province test range. The delimitations of an aircraft carrier deck show various types of impacts at different moments between 2004 and 2013. One target (image 4) seems to reveal an attempt to land missile warheads along the expected course of a moving target. Altogether its 24 hits, large and small ones, can be seen along a 1.3 km "trajectory". Chinese ballistic missiles were tested against sea-based targets in 2019 and 2020. Russia, meanwhile conducted various tests with new families of anti-ship cruise missiles, among which the hypersonic Zircon, which was first launched from a ship in 2020.

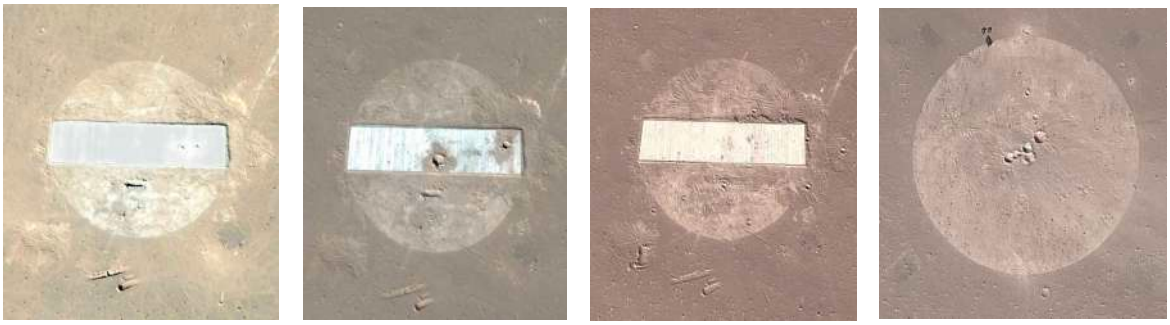

Image 3. Chinese ballistic missile tests against aircraft carrier mock-up. 2004: two small hits, 2006, two large hits, 2012: about 11 misses, 2013, on a similar target, 7 hits. Source: Maxar, 2004, 6, 11.

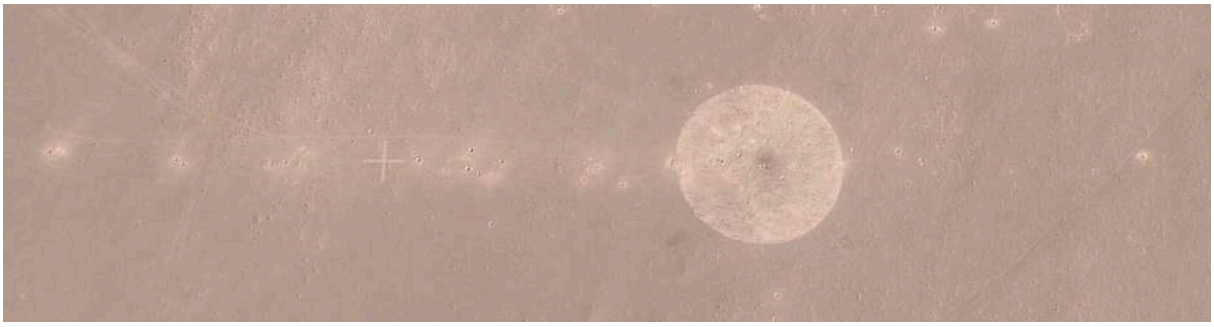

Image 4. Possible "trajectory" impacts. *Source:* Maxar, 2013.

The importance of defence. Long-range air and missile defence systems are also part of this active defence strategy. Characteristic of these systems is that they detect and engage aircraft at a distance, before they can use standoff-weapons. In its last strategic doctrine, Russia explicitly stated that it considers the development of missile defence with likeminded

[32] For instance: Li, Wen, 2020. 鹰击-12B 岸舰导弹，近海防御超级杀手 Ying Ji-12B shore-to-ship missile, offshore defense super killer, *China Youth Daily*, 23 April 2020.
[33] Li, Ming, et al. 2017. 基于系统动力学的反舰导弹饱和攻击模型, Saturation Attack Model of Anti-ship Missile Based on System Dynamics; Jia, Zhengrong, 2015. 反舰导弹饱和攻击时差规律研究, Research on Time Difference in Anti-ship Missile Saturation Attack. Electronics, Optics and Control. Summer, 2015.

countries a priority and recently agreed to work with China towards an integrated air defence system.[34] Chinese and Russian air defence is first of all about recognizing the complexity of this warfighting domain by combining a wide range of sensor systems, with various ranges and bands that can find different sorts of targets, with different radar frequencies, speeds, and so forth. Next comes the engaging of targets from different directions, as far as possible from the border, and to quickly protect air defence systems by limiting engagement radar activity, relocating systems, to counter jamming, and to factor in redundancy.[35]

Russian and Chinese sources affirm the importance of guided conventional missiles in active defence. But they never come alone. The best way probably to summarize their use is mass precise missile campaigns in support of mass manoeuvre. The ultimate goal in warfighting is to get boots on the ground and to prevent adversaries from stopping it. It is hard to say to which extent active defence will remain defence. Many aspirations that the West finds offensive, towards Taiwan, the South China Sea, the Arctic, and the Baltic, for instance, are seen as just and legitimate from the standpoint of Beijing and Moscow. What will partially determine China and Russia's readiness to advance in these areas, is whether they continue to alter the military balance. Conventional missiles in that regard remain key.

Looking far

Active defence is impossible without looking far ahead. China and Russia have modernized capabilities to monitor their borders and neighbourhood. "We did not even know where the Japanese and Americans were," a Chinese officer once remarked, "They could literally operate just before our coast without being detected."[36] Russia too saw its surveillance capacity diminish, because a part of the littorals of the Baltic, Black Sea, and Caspian Sea came under control of independent states and because former Soviet capabilities fell in disrepair. That has changed. Both Russia and China now field a broad range of capable channels through which they can acquire and process intelligence. Human intelligence is a factor often overlooked. But besides regular human intelligence gathering, both China and Russia have an outspoken propensity to use their diaspora and civilian assets – from fishing boats to merchant ships – for security purposes.

Air - Both China and Russia field significant numbers of dedicated patrol and early warning aircraft. Since the early 2000s, China has a limited early warning and control capacity, based on the Russian Il-76 and the Y-9 platforms. Since, various testbeds have been finalized. About 30 KJ-200 and KJ-500 AWACS and 10 KQ-200 maritime patrol aircraft have become operational. New variants are being developed. The compact Y-9-based systems allow China to monitor most of its adjacent waters. The Hong-6 continues to serve as a long-range surveillance aircraft and maritime bomber. Russia has long continued to use Soviet legacy aircraft, such as the A-50 AWACS and the Tu-142 maritime patrol aircraft.[37] It slowly prepares replacement with A-100 AWACS and the Il-114 maritime patrol aircraft.

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[34] The military Doctrine of the Russian federation. 25 December 2015, § 21.k.

[35] Wang, Fengshan, et al., 2008. 现代防空学, Modern Air Defense. Beijing, China: China Aviation Industry Press. For a great discussion: Lin, Bonny, and Christina Garafola, 2016. *Training the People's Liberation Army Air Force Surface-to-Air Missile (SAM) Forces.* Santa Monica: RAND.

[36] Conversation, Amsterdam, August 2013.

[37] A discussion of their limitations: Gorbachevsky, Andrey, 2019. Но можем собственных Цирконов. Still, We can have our own Zircons. *Novaya Gazeta*, 21 March 2019.

These manned aircraft operate alongside a rapidly growing fleet of long-endurance unmanned aerial vehicles. Chinese drones such as the BZK-005 and the new WJ-700 have a range of over 2,000 kilometres and an endurance between 20 and 40 hours. The BZK-005 is intensively used for reconnaissance missions above the South and East China Seas. Since 2015, Russia operates the medium-range Forpost drone above adjacent seas. In 2020, it has started introducing the Altius long-endurance unmanned aerial vehicle. Traditionally, Russian multirole fighters feature potent long-range multirole radars such as the Bars and Irbis. Russia might fit modern fighter jets with Byelka radar system features X- and L-band arrays that allow for the detection of small objects at a range of 3-400 kilometres. Most Chinese fighters still fly on less advanced radars, but this will change with multi-function radar systems like KLJ-5, KLJ-7A (X-band), developed on Russian radars, and the highly compact and powerful LKF601E (x-band), which have detection and search ranges between 150 and 220 kilometres.

Sea - The Russian navy equips its corvettes with the Zaslon active X- and S-band and additional passive L- and Ku- radars. Both systems have substantial EW capacity. Modern frigates are equipped with a modern 5P-27 Furke radar and a secondary 5P-20K Poliment air defence radar. Chinese navy ships have seen a stellar improvement in surveillance radar capacity. The introduction of the Type-346 and especially its B-variant equips powerful surface combatants with powerful C-, S- and X-band antennas with a range up to 500 kilometres. Smaller radars are the Type-515, 382, and- 360. All radars are expected to be robust in EW-contested environments. Surveillance capacity will be enhanced by forward deployed stationary sonar systems. China is known to have deployed sonar systems as far as the Mariana Islands, is very rapidly developing a network of seabed sensors in the South China Sea, and has a broad "transparent ocean" programme involving various undersea sensor systems.[38] Russia, meanwhile, has deployed stationary sonars, type MGK-608E, in the Baltic Sea. A Russian surface wave glider was recovered as far as Scotland.

Land-based - Since 2010, Russia has started to build a multi-layered network of air and ballistic defence early warning radars. The nine Voronezh radars can detect hundreds of small-signature airborne targets thousands of kilometres far. As a second layer, Russia has deployed at least two large Konteyner radars with a reported range of 3,000 kilometres and eight Rezonans-N early warning radars that can detect and small-signature airborne targets as far 1,000 kilometres. Five such radars are in Russia, one in Iran, Egypt, and Algeria. A new Vitim radar is expected to complete this early warning radar network.[39] This early warning network is followed by a network of mobile air defence radars; such as the 91N6 Tombstone, 59N6 Protivnik, 64N6 Big Bird, 76N6 Clam Shell P-18-2 Prima, Nebo-SVU, and the Struna-1/Barrier. It is the combination of these surveillance and acquisition radars that constitute a formidable second layer of surveillance against large numbers of stealth aircraft and fast incoming missiles (as far as 400-600 kilometres). A third layer of static and mobile coastal surveillance radars designed to monitor shipping and air traffic. The Podsolnukh (Sunflower) and Laguna-M radars do so with a range up to 200 and 450 kilometres.[40] The mobile MYS-M1E and Monolit-B also have a range up to 200 and 450 kilometres. The volume of data generated by these sensors is massive. Mobile command and control systems, such as 55K6, are expected to support this process, to be connected via new data links such as OSNOD and to feed into the new Automated Command and Control System (ASU/ YeSU-TZ) that Russia is rolling out, being it with difficulties.

[38] Video (link).
[39] Corporate brochure (link).
[40] Corporate brochure (link).

China too is enlarging its land-based surveillance capabilities. Two JL-1A X-band radars with a presumed range of 5,000 kilometres are built near Huanan and Hangzhou. The systems seem similar to the Russian Voronehz. Another variant, presumably P-band, is built in Shandong Province. Three surface-wave installations (emitters and receivers separated) with a range of at least 3,000 km were commissioned since 2016. The static Russian Podsolnukh is built for targets as far as 300 km. China has about 15 stations, managed by the State Oceanic Administration, which are tasked to monitor the dense maritime and air traffic inside China's exclusive economic zone.[41] China's third layer of mobile surveillance radars is developing faster. The JY-27A (VHF band), JH-26 (VHF-UHF), YLC8B (UHF), SLC-7 (L-band), YLC-2 and -2V (L, S-band), JYL-1 (S band) are now all operational and can identify airborne threats as far as 450 kilometres.

Satellites also remain indispensable for surveillance. They are used for traditional surveillance, but also increasingly for detecting and tracking targets that travel long distances, such as missiles and ships. Military surveillance is best served by a combination of satellites that collect optical images, radar images, radio signals, and infrared images. The capacity of earth observation is influenced by the number of satellites, which determines the surface that can be monitored, their accuracy, the frequency of passages, which determines the permanency of monitoring and the capacity to track moving targets, and the data processing capacity. Both quality and quantity matter. The United States and its allies had an important advantage in this regard, owning most earth observation satellites.

Russia inherited various optical and radar observation satellites from the Soviet Union, but modernization efforts have been limited. In 2016, the plan was announced to increase the number of state-owned remote sensing satellites from eight to twenty.[42] But this programme only advanced slowly. In 2019, there were still only 11 satellites. Sixty percent of the Russian territory was not effectively covered.[43] But the plan was reiterated.[44] China, by comparison, has moved faster. In 2006, China launched the first Yaogan satellite. It is the largest remote sensing satellite programme in the last decades, consisting of 33 satellites or constellations. They combine optical, radar, and electronic intelligence. In 2010, China started building the High-Definition Earth Observation Satellite (Hdeos) network, followed by the High-resolution Earth Observation System (Cheos). It consists of fourteen optic satellites or constellations. The majority of the satellites are positioned to focus on the Pacific. A leading expert commented that China has obtained 85 per cent self-sufficiency in remote sensing and that the resolution of both optical and radar satellites range between 0.1 to 1 metre, but that the capacity to provide all-weather and dynamic surveillance on the extended neighbourhood would require an increase to at least one hundred remote sensing satellites and a much stronger communication system. "A Chinese satellite captured the location of pirates (in the Indian Ocean), but we had to wait until it travelled back over China to download the information. By then, five hours later, the pirates were gone."[45] So, while satellite remote

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[41] Presentation (link)

[42] Estimated composition: 3 "Resurs-P" satellites, 5 "Kanopus-V", 3 "Electro-L", 3 "Meteor-M", 4 "Resurs-PM", 3 "Arktika-M", 2 "Kondor- FKA "and 2" Obzor-R " (Link).

[43] земля из космоса: дистанционное зондирование в россии, Earth from Space. *Remote Sensing in Russia*. Issue 1 2019, p. 12.

[44] Рогозин анонсировал проект «Государево око» Подробности. Rogozin announced the project "Gosudarevo Eye" Regnum, 19 January 2019: The goal was to have 25 satellites or constellations: 3 "Resurs-P" satellites, 5 "Kanopus-V", 3 "Electro-L", 3 "Meteor-M", 4 "Resurs-PM", 3 "Arktika-M", 2 "Kondor- FKA "and 2" Obzor-R

[45] Li, Deren, (interviewed), 2020. 从对地观测卫星到对地观测脑. Chinese Society of Surveying and Mapping, 9 November 2020:

sensing is probably emerging in the Western Pacific, broad dynamic coverage demands further investment.

Land-attack guided missiles

Long range precision strikes are no magical bullet. Conventional missiles remain vulnerable, can miss their target, and need to be fired in large numbers to destroy extended targets, such as ports, military bases, airports, and so forth.[46] Even hypersonic missiles have limitations. It usually requires dozens of conventional high-explosive missile warheads to destroy an air base.[47] Long-range precision strikes are still most effective against high-value point targets such as radar systems and single platforms, such as ships and aircraft. But as those come in large numbers and are usually also dispersed, it still requires significant quantities of missiles. As part of its global power projection capacity, the United States, for instance, is reported to have a stockpile of several thousands of cruise missiles.

While the United States possesses a vast arsenal of long-range cruise missiles, China has a large stock of short- and medium-range conventional ballistic missiles: between 750 and 1,500 DF-11, DF-15, relying for about 250 launchers, and between 230 and 510 medium- and intermediate-range ballistic missiles for 230 launchers, type DF-21, DF-16, DF-17.[48] Recent types are reported to be accurate and more capable of penetrating defence systems. Medium- and intermediate range ballistic missiles usually carry warheads that are heavier than those of cruise missiles. The DF-17 has a hypersonic manoeuvrable warhead. Most of China's conventional ballistic missiles are land-based. Launched from continental China, they can hit targets from Taiwan to Guam. China's arsenal of conventional ballistic missiles is sizeable. In addition, China is rapidly enlarging its cruise missile stockpile. Today, China has around 270-540 ground-based long-range cruise missiles, type DH-10 and DH-10a

Russia's offensive capabilities have been steadily growing since the turn of the century. The most dramatic change has been the introduction of advanced missile systems. Russia now fields about 12 rocket brigades with each about 16 launchers, each holding 2 missiles, type-Iskander 9M723 (Stone).[49] This solid-fuel ballistic missile has a range of 500 kilometres and features advanced combined guidance. Those missiles would engage high-value targets and could do so at this stage in volleys of over 32 missiles per brigade. Reload time varies between 20-30 minutes. Any such strike would most likely involve dozens of mobile launchers – out of a national total that could reach 190. Since 2017, Russia has deployed the 9M728, a medium range cruise missile with a range of around 490 km. At least four battalions are equipped with these missiles, each likely comprising four launchers that, in the latest configuration, can each

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[46] Tang, Zhicheng, 2015. 高超音速武器无法被拦截是伪命题, A Hypersonic Weapon That Cannot be Intercepted is a Pseudo-Proposition, *Ordnance Knowledge*, February 2015; Guan Wan and Hua Xiang, 2020. 高超声速飞行器对战场环境的影响, The Impact of Hypersonics on the Battlefield. *Cruise Missile*, March 2020; Novichkov Nikolay and Kostin Vasily, 2019. Новая крылатая ракета морского базирования ослабит ударный потенциал New sea-launched cruise missile will weaken the strike potential of the Russian Navy. Military-Industrial Courier, 14 January 2019.

[47] Stillion, John and David Orletsky, 1999. *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic-Missile Attacks*. Santa-Monica: Rand.

[48] Office of the Secretary of Defense, 2019. *Annual Report to Congress, Military and Security Developments Involving the People's Republic of China 2019*. Washington: DOD, p. 47.

[49] Stepovoi, Bogdan, 2019. бригадамИскандеровувеличили огневую мощь. Iskander Brigades Will Have More Firepower. 19 December 2019.

hold four missiles.[50] The road-mobile 9M729 cruise missile has a range between 1,000 and 2,000 kilometres.[51]

The combination of significant numbers land-based road-mobile ballistic and cruise missiles, dispersed over a large theatre, poses a significant challenge, particularly if those launchers are flanked by air defence systems. Russian experts indicated that this is not yet sufficient and that more missiles are required to destroy military bases in a single salvo.[52] But the value of long-range precise ground-based missiles has been proven in Syria. More important is its inclusion in Russia's warfighting doctrine and training practices, which allows the capacity to be scaled up flexibly, depending the conflict intensity and scale. The doctrinal shift, so far, is as important as the operational shift. New variants, such as the hypersonic land-based Kalibr 3M54 and Zircon 3M22 could continue to improve both range and survivability in the future.

Active defence holds that attacks are carried out from the motherland. This gives China and Russia an advantage. Road-mobile cruise and ballistic missile launchers are relatively cheap and can be easily dispersed. For the United States, the cost to project power in the margins of Eurasia is higher. Its partners, such as Japan and most European countries, also have rather limited land-attack missile capabilities. Active defence campaigns, limited wars under high-tech conditions, will most likely be concentrated attacks supported by dispersed missile launchers, whereas the defence will have to be executed by a limited number of platforms against a very large number of targets. Concepts such as mosaic seek to remedy this to some extent, but it will take time to put it into practice. The upper estimation of Russia's land-based land-attack (cruise and ballistic) missiles is 400-500; for China, this is already 2,500-3,000. This comes close to the current US inventory of +4,000 Tomahawk cruise missiles.

Anti-ship guided missiles

China is rapidly expanding its shore-, air- and ship-launched anti-ship cruise missile (ascm) capacity. The extent to which these missiles are tested, used in exercises, and their factory production lines have expanded. The stockpile of modern anti-ship missiles, primarily the supersonic YJ-12 and the subsonic YJ-83, must be impressive. The ship-based capacity, for now, is primarily spread over about 130 small ships. The T-022 and T-056 missile boats and corvettes have a combined 870 dedicated anti-ship missile launchers. This equals the full launch capacity of ten American destroyers. These small boats once more allow for dispersion, are designed for attacks from the vicinity of China's cluttered coast, and hence increase the burden on adversaries in terms of ISR. Increasingly, this small-ship strike power is complemented by larger ships. China's future fleet of destroyers and frigates will have at least 3,100 launchers, usually for both anti-ship, land-attack and surface-to-air missiles. This sea-based capacity is completed with mobile shore-bases YJ-12b launchers, also placed on some of the islands in the South China Sea, and an air-launched variant. In the coming years, the YJ-100, a supersonic missile with a range over 1,000, will come into service.

The latter will be similar to the Russia Bastion mobile coast-based missile batteries. An important development in the Russian Navy is the continued expansion of a fleet of small corvette-size platforms with significant long-range missile fire power. So far, 36 platforms

[50] Video clip (Link).
[51] This system has four tubes per launcher. See a briefing on this system by the Russian MOD (link). For a good discussion: Luzin, Pavel, 2020. Russia's Land-Based Cruise Missiles as a Political Tool Publication. Eurasia Daily Monitor, 17, 156.
[52] Ramm, Alexey, 2019. Спорная солянка: нужны ли России крылатые ракеты средней дальности, Controversial hodgepodge: does Russia need medium-range cruise missiles. Izvestia. 5 February 2019

type Buyan-M, Steregushchiy, Gremyashchiy, and Karakurt, commissioned and planned, will come with a theoretical total of over 540 VLS-tubes, mostly Redut-type launchers that can fire R-500, Zircon, Kalibr and other cruise missiles. Even if these ships feature limited sensor capacity, when deployed in a network with larger surface combatants or aircraft, the sheer number of ship complicates the outlook. [53] The Soviet debate about naval strategy focussed a long time on the choice between many small ships and few large ocean-going ships. Today, that debate continues. Experts acknowledge that a "mosquito fleet" of small ships is useful to defend Russia's vicinity, but those need to be combined with large platforms, submarines, and shore-based batteries.[54] Media reports suggest that the introduction of Kalibr missiles has been slow, that the production plant has difficulties, and that the Russian military only receives around 100 of such missiles on an annual basis. The current number of cruise missiles is still dwarfed by American fire power.[55]

In the future, anti-ship strikes might be executed with ballistic missiles. While the DF-26, -21D are reported to be highly accurate and their manoeuvrable warhead designed against sea-based targets, many specifics of these missiles remain unknown. The testing of these missiles against a sea-based target in the South-China Sea, in August 2019, confirmed the expectation to deploy such missiles from launchers spread over Chinese territory, their accuracy, but not yet the supporting ISR systems or active radar-homing on highly defended moving targets in cluttered theatres.[56] For now, the missiles reveal an important vector in China's plans for anti-ship capabilities, which will also involve hypersonic glide vehicles (type DF-ZF), but not yet warfighting readiness. This is also acknowledged in some Chinese sources.[57] The aim of China is to deploy such missiles in so called multi-missile cooperative attacks or multi-direction saturation attacks (多向导弹饱和攻击), in other words, to build in redundancy and to enhance survivability. To force adversaries to use more launch systems for missile defence also reduces their offensive capacity, especially because reloading air defence missiles at sea is not evident.[58] Multi-direction saturation attacks also involve the deployment of anti-ship cruise missiles. The Chinese example has inspired Russia.[59]

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[53] Nersisyan, Leonid, 2019. Нужны ли России малые ракетные корабли? Does Russia Need Small Rocket Ships? New Defense Order. Strategies, 4, 57.

[54] Azanov, Roman and Dmitry Fedyushko, 2019. "москитный флот"? Is Russia creating a "mosquito fleet"? TASS 12 July 2019.

[55] Сотни Калибров против тысяч Томагавков. Hundreds of Kalibrs against Thousands of Tomahawks. Inforus, 12 December 2019; Novichkov Nikolay and Kostin Vasily, 2019. «Калибром» по своим Новая крылатая ракета морского базирования ослабит ударный потенциал ВМФ РФ New sea-launched cruise missile will weaken the strike potential of the Russian Navy. Military-Industrial Courier, 14 January 2019.

[56] Ni, Chun and Jiang Peng, 2020. 反舰导弹战斗部对舰船毁伤效能试验评估方法研究 Research on Evaluation Method of Damage Effectiveness Test of Anti-ship Missile Warhead to Ship, *Cruise Missile*, February 2020.

[57]东风 26 只是一款"假"反舰弹道导弹？连美军司令都怕了 *Sina News*, 22 December 2020.

[58] Zholobitky, A.I., 2019. О способ поражения кораблей из состава авианосной ударной группы противника, On the Method to Attack Ships from an Enemy Carrier Strike Group, Aerospace Forces. Theory and Practice, December 2019, p. 20.

[59] Sivkov, Konstantin, 2020. С эсминцем против стратегической ракеты , A destroyer against a strategic missile. 30 November 2020; Zholobitky, A.I., 2019. О способ поражения кораблей из состава авианосной ударной группы противника, On the Method to Attack Ships from an Enemy Carrier Strike Group, Aerospace Forces. Theory and Practice, December 2019.

Air-defence missiles

China and Russia field a large number of short to long-range surface-to-air-missiles. Russia inherited from the Soviet Union over 1,900 road-mobile long-range missile launchers, good for over 7,000 surface-to-air-missiles. Today, the inventory of Russian long-range missile launchers is closer to 1,100, good for over 5,000 missiles. These primarily include modern S-300 variants and about 180 S-400. These long-range missiles come on top of large quantities of short-range and point defence missile systems. The main change since the Cold War, has been the introduction of advanced radars – type 76N6 and so forth, missiles against low-altitude targets, such as the 9R31M and 48N6, and long-range anti-radiation missiles. China catches up, although it has less experience.[60] In 2000, it still only had a few dozens of Russian S-300 launchers.[61] Today, it fields around 1,000 long-range air-defence missile launchers, atop a very large number of medium to short-range systems, mainly type HQ-9 and S-300, and, in small numbers, the recent HQ-22.[62]

While no defence system is impenetrable, these air defences are vast. Russia and China could collectively have over 2,000 land-based mobile long-range air defence launchers, which are capable of firing 8,000-10,000 missiles, before being reloaded. These systems severely limit the freedom of action of older combat aircraft, still the bulk of Western air forces, and complicate operations of fifth generation combat aircraft.[63] The situation is further complicated because air defence missiles will also have to stand up to long-range missile strikes, not only to aircraft. On the other hand, however, air strikes will also be countered air-to-air by fighter aircraft. Chinese and Russian air defence is forward leaning. Air defence radars in places such as the Crimea, the Belarus, the islands of the South China sea, and, especially in case of China, on a growing fleet of large surface combatants, gives them an advantage in response time.

The main strength of Chinese and Russian air defences is the combination of range, dispersion, and redundancy. The sheer number of systems and their range way beyond the national borders demands hundreds, if not thousands of missiles, or vast EW capacities, to be pinned down on those air defence batteries alone. Air defence missile redundancy becomes even more pronounced when the inventory of combat aircraft owned by the competitors of Russia and China continues to fall. To date, competitors of Russia and China only have a few dozens of fifth generation aircraft permanently deployed in Asia or Europe. Acknowledging shortfalls, China and Russia agreed to work together to build a modern integrated air defence system. [64]

Production sustainability

Both Russia and China are expanding their conventional guided missile capacity. Russia essentially relies on new design bureaus on Soviet factories that have hardly expanded in the last twenty years. Russian sources also continue to complain about limited production output and delays. There is no evidence that these production limitations have been or will be addressed. This is different in China. Beside fast modernization of PLA Rocket Forces facilities

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[60] Bronk, Justin, 2020. Modern Russian and Chinese Integrated Air Defence Systems. London: RUSI.
[61] Japan, by comparison, only fields 120 Pac-2 and Pac-3 missiles.
[62]直击演训场：利箭出击解放军新型防空导弹曝光！Direct attack on the training ground: The new type of anti-aircraft missile of the People's Liberation Army is exposed! CCTV 7, 16 November 2020
[63] Heginbotham, Eric et al. 2015. *The U.S.-China Military Scorecard*. Santa Monica: Rand, p. 112.
[64]美军新型氮化镓雷达登场 探测距离超红旗 9 雷达数倍, The U.S. Army's New Gallium Nitride Radar Deployed with a Detection Range Several Times the HQ-9 Radar. *Sina Military*, 30 October 2019.

and launch bases, there is a lot of evidence of rapidly growing production capacity. A key facility for China's conventional guided missile production is the Fangshan missile factory, southwest of Beijing. At this side, multiple missile systems are assembled. Between 2010 and 2020, the plant surface expanded by at least 30 percent. Based on the images of mobile missile launchers being fitted out, it must deliver over 100 missile launchers a year. This also goes for the vast facilities of Factory 211, south of Beijing, and one of the main assembling sites of large ballistic missiles, and the Yongdong Road missile factory cluster.

Image 5. Fangshan missile factory in 2010 and 2020. *Source:* Maxar.

Image 6. Factory 211 in 2007 and 2020. *Source:* Maxar.

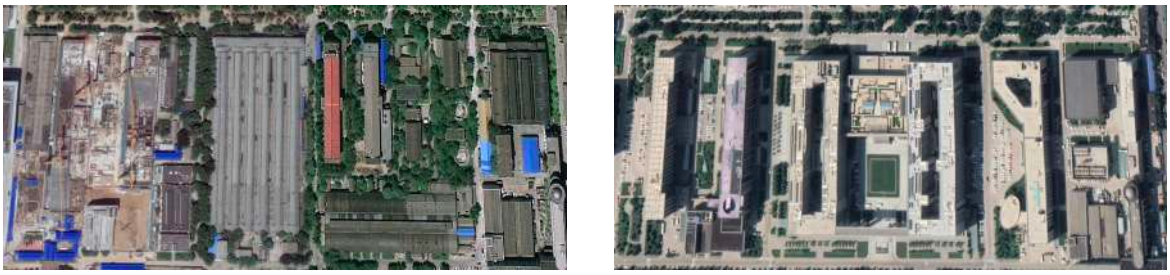

Image 7. The Yongdong Road missile factory cluster in 2009 and 2020 (CASIC 699 Factory, 283 Factory, 284 Factory). *Source:* Maxar.

Conclusions

For China and Russia, the nineties were a strategic wake-up call. Operation Desert Storm showed the advanced long-range strike capabilities of the United States and some of its allies, but also the limitations of Iraq's backward Scud-missiles system. The intervention in the Yugoslav War largely confirmed this concern and the exposure of countries to America's global strike power. While China and Beijing pursued a strategy of active defence, they seemed no match in local high-tech wars. This triggered a continued effort to modernize capabilities, to work towards networked warfare, and, most importantly, to try to deter the dominant maritime power from entering their sphere of interest. Active defence turned high-tech and extended its range. The foremost aim was territorial defence, but also to guarantee freedom of manoeuvre whenever other core interests were challenged. Think of Taiwan, the South China Sea, and so forth.

Conventional guided missiles were increasingly embraced as an important enabler of active defence. They were deemed indispensable to target critical infrastructure in the Chinese and Russian vicinity, damage command and control systems, but also to afflict so much damage to nearby adversaries that it would lead to demoralization. Those missiles also could bring an element of surprise and pre-emption in active defence campaigns, to stretch the battlefield. Both Chinese and Russian sources highlight the combination of saturation (mass) and precision, of dispersing missile systems and multi-dimension strike. Since recent years, Moscow and Beijing also put emphasis on using missiles to undermine the naval preponderance of the United States and its allies, by means of hypersonic missiles and ballistic anti-ship missiles. Conventional guided missiles are considered a precious tool for broadening deterrence and increasing escalation options.

The two countries have added large numbers of missiles to their stockpiles. The upper estimation of Russia's land-based land-attack (cruise and ballistic/ short-intermediate-range) guided missiles is 400-500; for China, this is already 2,500-3,000. They have commissioned many small ships that carry hundreds of anti-ship missiles. If the United States and its allies deploy a large number of mainly surface combatants with land-attack cruise missiles, China and Russia have long focussed on what some call a mosquito-approach. Yet, in this domain too, China is moving quickly and could soon have a fleet of destroyers and frigates with at least 3,100 launchers. This does not yet equal America's global maritime strike capacity, but for concentrated active defence, that capacity is already significant. A third very important dimension of Russian and Chinese conventional guided missiles concern air-defence systems. In this domain, the two countries field unequalled numbers of launchers and missiles. Russia and China could collectively have over 2,000 land-based mobile long-range air defence launchers, which are capable of firing 8,000-10,000 missiles, before being reloaded. These severely limit air force manoeuvre in their neighbourhood, as well have a BMD-relevance. Moscow and Beijing also work towards integrated air defence,but the evaluation of this specific domain goes beyond the scope of this paper.

While the approach of Russia and China is similar, China rapidly leaves Russia behind in missile quantities. Recent tests, exercises, and especially its booming production facilities underscore the enduring importance attached to conventional guided missiles in future warfare and their relevance in weakening the traditional power projection advantages of its adversaries.