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Hypersonic Hype – Revisited

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In March 2019, we published an analysis entitled *Hypersonic Missiles – a Political Multipurpose Weapon*. It was aimed at evaluating political and strategic dimensions of the development of hypersonic weapons against the background of technical, operational and economic realities. The basic conclusions we reached at that time are valid now as well. However, some important recent developments in this field are worth noticing. Thus, in the present analysis we will depict how the maturation of the weaponry mentioned two and a half years ago has progressed and what is new within the realm of hypersonics. We will also offer some slightly updated strategic assessments.

1. The Previous Assessment

In this article we will not repeat a "hypersonics 101" with technical description, definitions and capabilities assessment, as it was enclosed in the article mentioned above and which is easily accessible. However, the main conclusions are worth reiterating because they form a starting point of our argument here.

And so, we ascertained that two basic technologies were available at the time to be developed into weapons systems. Hypersonic glide vehicles (HGVs) and hypersonic cruise missiles (HCMs)

both were promising concepts, of which the former was much more mature, and it posed a much lesser technological challenge. We agreed that the operational weapons systems which would emerge from these ideas would become formidable addition to the already existing arsenals. Specifically, they promised to give somewhat improved capabilities compared to ballistic missiles and crewed aircrafts. On the other hand, we noted that the development and procurement costs of novel weapons would be very high. We also pointed out important operational constraints on the use of a novel weaponry. This way, as we argued, the significant enhancement of the overall capabilities of the long-range strike forces belonging to the leading powers would surely come at a very great cost. It would also take time and allow the adversary to prepare defensive and offensive capabilities, diminishing a possible advantage.

All in all, we expected no significant shift in the strategic balance due to the development of hypersonic weapons to occur in the foreseeable future. We also argued that only low-flying HCMs might become a real game-changer if deployed in significant numbers. Nonetheless, they also posed the greatest technological challenge, so they were not on the horizon.

More specifically, we maintained in Spring 2019 that China and Russia were not supposed to quickly field large numbers of long-range HGVs, even though a deployment of related systems seemed to be approaching. Thus, both countries could not expect to tilt a strategic balance with the United States in the foreseeable future. Consequently, the primary goals behind the development of these weapons were of political nature. Aside from gaining valuable knowledge which could be used for many purposes, all the tangible advantages were political. First of all, by fielding that kind of weapons the U.S. did not possess, both countries would prove to be superior to their archenemy. It was not only a matter of international prestige but also of national pride and legitimization of the authorities. Specifically, Russia's waning economy and the internal social crisis left its leaders with a shrinking range of opportunities to show their effectiveness. Advertising of novel weapons and purported superiority over the U.S. was a particularly important way for the Kremlin to show strength, or what was left of it. For China, an ascending rival of mighty America, any achievement in cutting-edge technologies, especially a military one, was a very welcome proof that the Middle Kingdom had actually ascended to the rank of a world-class superpower. The assessment of the development of hypersonic weapons in the United States was rather different. We expected a relatively quick pace of that development and a high deployment rate of several types of these weapons by the U.S. military.

To summarize, in Spring 2019 we argued that from the point of view of China and Russia, hypersonic weapons were mostly of political value. Their formidable capabilities did not form any strategic breakthrough because of two reasons. Firstly, due to the high development and procurement costs, we did not expect hypersonic systems to be fielded in significant quantities. Secondly, we argued that probably all of the missions that might be attributed to the HGVs, being still in the development phase, could be executed by ballistic missiles with almost the same effect but at a much lower price. Thus, only a massive and quick deployment of hypersonic weapons replacing deployed ballistic missiles could change the strategic balance, but we deemed it impossible due to the existing economic and operational constraints. On the other hand, we expected that the United States would quickly catch up with hypersonics. But this would not change the existing strategic balance as well, owing to the already existing overall American preponderance.

2. Current Developments of Hypersonic Arsenals

In our analysis of 2019, we enclosed detailed information about weapons called hypersonic by the respective governments. It included publicly available technical data and an assessment of these systems' capabilities. Below we will briefly describe the development of these weapons systems since then.

Russia

Although it is neither an HGV nor an HCM, the air-launched H-47M2 "Kinzhal" (X-47M2 "Кинжал") is widely and loudly advertised as a hypersonic weapon and therefore has been taken into consideration. After we had completed our previous assessment, it was flight tested in 2019, and two pieces were deployed in Syria in June 2021. Official Russian sources claim that the missiles were used as part of a drill and were fired at "virtual" targets over the Mediterranean, but there is no independent verification of what did really happen. Note that there are no accessible data regarding the production, procurement and deployment rates of the "Kinzhals". It is worth noting that one "Iskander-M" missile, which is almost identical, was reportedly shot down by the Israeli-made Barak-8 air defence system during the Nagorno-Karabakh war of 2020. If true, it sheds new light on the purported invincibility of the "Kinzhals" as advertised by the Russian propaganda.

There is one more technical issue that requires clarification because it was not stated clearly enough in the previous analysis. It is usually said that the "Kinzhal" can reach the target up to 2,000 km away. But this number refers to the missile range plus the range of the carrier aircraft, MiG-31K (3,000 km if fired from Tu-22M3). The most important operational constraint which flows from this fact, and we failed to explain this adequately before, is that the carrier aircraft must cross outer defensive lines of the enemy to fire a missile against valuable targets deep into the enemy territory. It is not an easy task.

When it comes to the strategic "Avangard" ("Авангард") HGV launched atop UR-100NUTTH ICBM (SS-19, "Stiletto"), it seems that its deployment continues as planned. Two units were activated and began combat duty on December 27, 2019, and the next two were deployed in 2020; two additional units are expected to enter the service in 2021. There is no indication of the Russians' intent to expand the "Avangard" force beyond the already planned two six-unit regiments, which is supposed to happen by 2027.

The third, highly advertised Russian piece of equipment, the 3M22 "Tsirkon" (3M22 "Циркон"), is a hypersonic anti-ship missile. It was not mentioned in our previous article because any reliable data about the characteristics of this weapons system were unavailable at that time. According to current information, it is a sea-skimming missile with a range of over 500 km and a speed reaching Ma11. It has not been fielded yet, although several operational tests have been recently conducted. Therefore, it is quite possible that the weapon will enter production soon and will be deployed on large surface combatants and submarines. This weapon offers the capability to strike enemy surface ships much faster, leaving much less time for a reaction. In theory, and as it is advertised, it should be able to break all the defences that are in use by modern navies. However, there are important technical and operational constraints that overshadow this rosy picture.

The first problem is a relatively limited range of the missile, which requires that large surface ships or submarines get quite close to enemy forces. In practical terms, the Russian large surface task forces or individual submarines must overcome the outer defences of adversaries' fleets prior to firing of the "Tsirkons". In the current realities of warfare on the world ocean, with the U.S. Navy as the most probable enemy, it is highly unlikely that large Russian combatants reach the point where they could fire their missiles against the American battle groups. Submarines might fare somewhat better due to their nature but not much better. The U.S., British, French and Japanese navies possess extensive anti-submarine capabilities, including large forces of attack submarines designed specifically to hunt and kill other vessels of this class. Therefore, we believe that in the case of a conflict, it would be very difficult for Russian "Tsirkon"-carriers to reach their firing positions against U.S. surface groups.

The second problem relates to missiles' guidance systems. In theory, at Ma11 in dense air close to sea level, a missile is surrounded by the ionized air forming a highly compressed and hot plasma sheath which prohibits any electromagnetic emission from going through. Thus, it is difficult to send guidance commands to a missile which in addition cannot use a self-guidance because it is virtually blind. It is, of course, possible that the Russian engineers have managed to overcome these problems, but it is more likely that the weapon is unguided. This way, only the use of a nuclear warhead could give it some effectiveness, but not necessarily. Modern ships can withstand a blast caused by a small nuclear device exploding as far as several kilometres away. Furthermore, the "Tsirkon" in-flight will be highly detectable by air- and space-borne ISR assets. In three minutes, the U.S. aircraft carrier can move three km in any direction due to its high manoeuvrability. In most cases, it would be enough to avoid a hit by the unguided "Tsirkon", even if it is nuclear-tipped.

And so, the impact of deployment of the "Tsirkon" missile on military balance is negligible. Certainly, it is a formidable weapon, and it does give Russia somewhat new capabilities, particularly in coastal areas while conducting defensive operations. But by no means it changes neither the current state of balance between U.S. and Russian navies nor the overall domination of the U.S. military.

China

The most mature hypersonic weapon developed by the Chinese is the DF-ZF HGV launched atop the DF-17 MRBM. It has been declared initially operationally capable after 18 units have been displayed on military parade held on National Day of PRC, on October 1, 2019. In addition to what was previously known, this missile is indeed highly manoeuvrable and accurate against stationary targets. It is also believed that an anti-ship variant of the missile is under development, but there has been no clear information about that. No data about production and deployment is available, as it is even uncertain if all displayed units have actually become fully operational.

A "Starry Sky 2" ("Xing-Kong – 2") is another Chinese hypersonic weapon, but there is no new publicly available information concerning this weapon.

The United States

Several R&D programmes advanced in the United States are supposed to lead to the hypersonic weapon we mentioned in our previous analysis. There is a lot of buzz in the media outlets and professional journals, but only two important developments are worth noticing.

Firstly, there is a significant delay in the development of the AGM-183A in comparison to the previous, highly optimistic assessments. It was unsuccessfully tested three times in 2021, and currently it is not clear when the weapon, which was supposed to become operational by 2021, will finally enter the production phase. In September 2021, Air Force Secretary Frank Kendall expressed concern that about the progress of the works and also said that he was "not satisfied with the degree to which we have figured out what we need for hypersonics, of what type, for what missions." Nonetheless, the U.S. Air Force expects to start production of the weapon in 2022; funding of the first 12 units is enclosed in FY 2022 budget proposal.

Secondly, the HCM development is proceeding with some success. In September 2021, Raytheon's experimental missile designed under DARPA's HAWC programme was test-fired. Not much has been officially unveiled about the nature of the test besides the statement that it met its objectives. We may therefore speculate that the missile managed to maintain stable operation of scramjet motor through considerable time. If so, it is a substantial step in the development of HCM-class weaponry, unmatched by any other country. Currently, several leading arms manufacturers compete with their projects which are supposed to be tested in 2024 in cooperation with Australia.

India

India is a new contender in the hypersonic race, and there are numerous projects, which are labelled as hypersonic weapons, under development in this country.

The "Sharuya", test-fired in 2020, is called a hypersonic weapon, but most probably it is a variant of the K-15 "Sagarika" ballistic missile. This solid-fuel rocket engine powered weapon can be fired at a distance of 1,000 km, and it surely transcends Ma5, which is the benchmark of hypervelocity. But, as we stressed in our previous assessment, almost every ballistic missile is hypersonic by definition, even though it is neither an HGV nor an HCM. Regarding this missile, we think that the label "hypersonic" is used for political purposes, similar to the case of the "Kinzhal", which, as we know, is a highly manoeuvrable ballistic missile.

The Hypersonic Technology Demonstrator Vehicle (HTDV) which was tested in June 2019, is, as the name suggests, a technology demonstrator. It is designed to gather technical data that will eventually lead to the construction of an HCM. The data gathered may be used in the design process of the BrahMos-II, which is being developed in cooperation with Russia. It is supposed to be an HCM, a multipurpose air-breathing weapon system, however it has not been flown to date.

Additionally, in 2021 the project of an HGV, the HGV-202F, was unveiled by an Indian start-up company. Yet, there is virtually no information with regard to details. It is also not known if any talks about the contract with a financing authority have been underway.

North Korea

On September 28, 2021, North Korea fired a missile called "hypersonic" by the authorities in Pyongyang. Korean media have claimed that it did follow a non-ballistic trajectory for 200 km. The visual coverage published with this information does show a missile paired with a device that resembles an HGV concept. However, due to the nature of the Korean regime, it is impossible to assess if any of the published information is true.

3. Conclusions and Prospects

The most important conclusion which may be drawn from the above-mentioned observations has already been stated. Our assessment of the impact of the development of hypersonic weapons published two and a half years ago still holds for the most part true. Let us, therefore, reiterate that the weapons systems which are referred to as hypersonic are not game-changers in strategic terms. They are indeed formidable weapons, and they do bring some new capabilities to the battlefield. But, as the newest analyses also confirm, these new capabilities are not much greater than the existing ones. Furthermore, technical, operational, and to some extent, economic constraints limit the effectiveness of hypersonic weapons.

Nevertheless, there are some issues worth noticing which enrich the assessment published two and a half years ago.

1. One significant difference between where things stand now and our former predictions is the somewhat slower pace of the development of the American hypersonic weapons systems. But, on the other hand, we uphold our assessment that the United States will eventually be able to develop and field them in large numbers. This, in turn, will contribute to the stability of the existing strategic balance which is characterized by the overall advantage of the American military over the other countries. Undoubtedly, this preponderance is not as absolute as it was in the 1990s, but it still gives the U.S. relative freedom of military action in most places in the world.

2. It is noteworthy that there is no clear vision of using the AGM-183A ARRW, which is the first hypersonic weapon scheduled to enter service in the AU.S.A.F. in the coming years. Whereas Russian or Chinese systems like "Avangard" or"DF-17" have a relatively stable position among other weapons, the mission for the American one is not so clear. According to current estimates, which are, by the way, very scarce and not confirmed, AGM-183A is supposed to have a range of 1,000 km and an initial speed of Ma 7. Available photographs of the weapon attached to the B-52 bomber suggest that it is 6.5 m long, and its diameter is around 0.7 m. The forward warhead compartment which houses the HGV is only 1.7 m long. So, it is a relatively small weapon which can be fitted with several hundred kg of explosives or a small nuclear device. What exactly this kind of weapon could do much better than the existing cruise missiles or conventional ballistic missiles is uncertain. Surely, the rapid precision strike capabilities of the U.S. military will be somewhat augmented with the advent of this weapon. It will also contribute to the American effort in counter-terrorism and low-intensity conflicts. But is it worth the cost?

3. We may also offer some thoughts regarding the assessment of prospective hypersonic strategic game-changers. As we have already mentioned, an HCM is one, which could fly much lower than an HGV, ideally on the treetops level. If such a cruise missile is deployed in significant quantities, it

will render many defensive measures obsolete and will create new superb capabilities, meaningfully tilting the existing balance. Yet, based on the current developments, we believe that if this kind of weapon is finally developed, it will most probably be the U.S.-made one. We also hold that it is a matter of a rather distant future. The second possible game-changer is an anti-ship variant of DF-17. Suppose this weapon is deployed in significant quantities. In that case, the U.S. Navy surface task forces may find themselves being pushed beyond the 2,000 km perimeter from the Chinese mainland or even farther away. It is because, as it is commonly believed, this kind of weapon will be unstoppable due to the nature of hypersonic flight. However, there are important technical constraints for the development of such missile, specifically of its terminal guidance system. In any case, it will take time to manufacture an operationally capable missile of that sort, which will create an opportunity to develop countermeasures and defensive capabilities. Some technical realities should also be considered. Specifically, let us notice that the maximum speed that DF-ZF achieves when the DF-17 launcher burns out undergo significant reduction while it glides. Furthermore, any evasive manoeuvre, especially an aggressive one, deprives the missile of its energy and, consequently, of its speed. Therefore, while in the terminal phase, a future Chinese hypersonic carrier-killer will not necessarily travel faster than a ballistic missile of a similar range and payload. It will also not be able to manoeuvre extensively in its attack phase not to miss its moving target. Thus, it might be destroyed by the SM-2 or SM-6 terminal defence interceptors or their future incarnations. And so, large-scale deployment of DF-17 may not become a game-changer after all.

4. In April 2020, the Russian Foreign Minister Sergey Lavrov hinted that the limitation of hypersonic weapons might be discussed bilaterally with the United States. It was a part of the frantic Russian effort to save the arms control framework after the U.S. had withdrawn from the INF treaty in 2019. This offer served, as we believe, multiple political purposes. Firstly, it was a political demonstration that Russia was not only equal to the United States, but it was also a world leader in the hypersonic race. Thus, secondly, it was a gesture of goodwill and a sign that Russia was ready to slow down the race, which it was already about to win, for the sake of peace. Thirdly, it was another display of firmness of the Russian government guarding the security of the Russian people both by the strength of the military and through skilful diplomacy. If such negotiations took place, the ideal outcome for the Kremlin would be a treaty prohibiting hypersonic weapons. Its conclusion would emphasize Russia's equality with America, preserve the Russian purported technological advantage, and display how the peace-loving Kremlin worked to avoid a dangerous arms race. Aside from these political gains, Russia would avoid a costly competition, which is what the Kremlin wants the most. But nothing of this sort is going to happen, of course. On the contrary, the United States will most probably relentlessly pursue the development of hypersonic weapons until a clear qualitative, and quantitative advantage in that realm is achieved. This is what makes Russians extremely nervous because they understand well that they cannot withstand the next arms race with the U.S.

5. For India, a new contender in the race, the development of hypersonic weapons is another ticket to the club of the world's leading powers. Even if it is not going to yield strategic advantages, taking part in this race is alone a signal that the South Asian nation is a world-class competitor in every field. Additionally, New Delhi has always Beijing in its sights, as China is the single greatest rival of India in the strategic, political and economic realms. Therefore, the development

of novel weapons, not only hypersonic ones, demonstrates that the Indians remain vigilant and are ready to field capabilities similar to the ones the PRC possesses.

6. It is also worth noticing that numerous programs in the United States are being designed to improve the detection, tracking, and interception of hypersonic vehicles. But not only do strategic considerations govern this development, but there are also important political issues here. First and foremost, it is a matter of leadership. As the American influence in the world slowly diminishes, any sign of weakness is considered as very harmful. Consequently, as the American position in the world rests to a great extent on the might and global reach of its military, it is imperative that the world remain convinced about the American lead in that realm. Until recently, the United States has not considered it necessary to rush with hypersonic systems, as they were unnecessary owing to the overall American preponderance. But once the Chinese and Russians seem to be overtaking America in the novel technologies, the effort must be made to catch up and beat the contenders for political reasons in the first place. Secondly, there are obvious internal issues, with military branches vying for power and funds and politicians courting their constituencies. All in all, hypersonic weapons are of mostly political significance for the United States and political elites in the country.

To summarize, we may repeat the main argument that hypersonic weapons do not have the strategic and military value they are supposed to have. However, they are of great political value from the point of view of all the nation-states which take part in the hypersonic race.

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