Study

The Russian Battle for Air Supremacy Over Ukrainian Skies

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In modern warfare, it has become necessary for the attacking country to achieve air supremacy or at least air control at an early stage in the war theater, as the international coalition did during the Kuwait liberation war (1990-1991) against Iraq's air defense. This means that the attacking air force should have an integrated air combat system to ensure pilot efficiency and aircraft diversity. Moreover, it must have airborne radar stations to provide command and control, protect and monitor the skies, collect information, take aerial photographs, and provide mid-air refueling aircraft for reconnaissance. Electronic warfare planes are also needed to jam and blind the enemy's air defense radars, and a slew of attack planes to target the enemy's combat echelons and pinpoint and destroy its heavyweight posts and critical centers. To achieve this air supremacy, one of the two parties must win the so-called air-land battle.

The concept of air-land battle shaped the core essence of the war doctrine of the US army in Europe against what was known as the Warsaw Alliance from 1982 to the late 1990s. The forces needed to carry out the air-land battle include all the elements of land and air to serve a country's comprehensive military strategy in the theater of war.

The air-land battle aims to achieve operational objectives by coordinating combat missions between air and ground forces. The joint operations commander assigns a slew of aerial missions to ground forces, beginning with air interdiction (AI) missions, which necessitate detailed intelligence about targets deep within the operations theater in order to generate operational impacts that achieve the joint force's objectives. The goals include destroying the enemy's reserves, strategic points, heavyweight outposts, and rear combat echelons. Second, close air support (CAS) missions are typically provided by the air force to a ground unit or specific operation in order to facilitate the mission of making advances and the maneuvering of ground forces without any ground resistance from the enemy. This reveals the importance of the defending state — in the face of aerial operations by the enemy state — possessing an air force that should engage with the attacking

air force and defeat it in the aerial battle. There should also be ground-to-air defense systems to intercept and shoot down attacking planes and missiles to protect the advance of ground units.
The critical questions to be examined here are: how is this joint action carried out? How has the Russian air force fared from the start of the war until now? Has it achieved air supremacy over the Ukrainian war theater? How did the Ukrainian air force and air defense systems (ground-to-air) react? What lessons has the Ukrainian war taught us for future air-land battles?

How the Russian Air Force Fared in the Ukrainian War

During its wars in Chechnya, Georgia and Syria, Russia developed considerable expertise in striking targets. Syria served as a training ground for Russia's army and its new-generation weapons, which were put to the test, particularly aerial weapons. During the fighting in Syria, the Russians worked to rotate the greatest number of their generals and general staffs in leadership positions in order to hone their leadership skills and learn from real-life combat scenarios, particularly how to deal with an enemy that is nothing more than a scattered and disunited resistance that engages in asymmetrical warfare battles. As soon as they tested their weapons, readiness, leadership personnel and won the war, Russia believed that its combat readiness was complete to invade Ukraine and that its air force and ballistic missiles, accompanied by advances by its ground divisions, would result in the annexation of major Ukrainian cities, particularly Kyiv, and imposing a fait accompli that would force the Ukrainian government to surrender or leave the country. As a result, the Kremlin would find it easy to install a government aligned with it, not loyal to the West, declare a ceasefire, end the war, and claim to have eradicated what Russia described as Ukrainian Nazism.
This was the best-imagined scenario which Russia hoped to bring to fruition in record time. It appears that senior Russian leaders' strategic thinking did not take account of the fact that although starting a war is simple, it is difficult to control its consequences

and duration, and prevent the involvement of outside parties.
The Russians learned many lessons during the 2008 war with Georgia, the most important of which was the importance of disrupting hostile air defense systems before the battle. Georgia, for its part, entered the war with missile systems inherited from the former Soviet Union, such as medium-range fixed S-125M SAM missiles, the Buk-M1 mobile system, SAM short-range missiles, the Osa-AK mobile system, and Strela shoulder-fired missiles.
According to Ukrainian experts, the crews of the Buk-M1 and Osa-AK missiles were deployed in ambush mode and were receiving early warnings of the approaching Russian planes via the Georgian Kolchuga-M radars. The anti-missile batteries waited until the last possible moment to activate their short-range radars in order to avoid being affected by Russian aircraft's electronic warfare actions. Georgian defensive crews suffered losses but were still able to wreak havoc on the Russian air force. According to unofficial reports, the Buk-M1 missile system shot down four Russian planes on the first day of combat on August 8, 2008: three Su-25 attack planes and one Tu-22M3 bomber. On August 11, Georgia's Osa-AK reportedly shot down a Su-24M bomber and a Su-24MR reconnaissance plane, killing one of the latter's crew members. Three other Su-25s were damaged as a result of Strela shoulder-firedbombers.(1)
Georgian tactics, as well as the discipline of its missile crew, clearly contributed to the Georgian air defense's relative success. The damage inflicted on Russian squadrons by rocket-propelled grenades enraged Moscow's decision-makers, contributing to the Kremlin's decision to launch a large-scale air force reform program.
Russia takes pride in having the world's second largest air force, trailing only the United States. It is a highly advanced force with 1,511 fighter jets versus Ukraine's 125 aircraft. The Russian army has an air fleet which includes 789 fighters and 742 attack aircraft, according to the Flight Global 2022 World Air Force manual. The Russian army possesses 1,540 military helicopters, 538 of

(1) David Axe, "War With No Air Power? Eastern Ukraine Could Be Too Dangerous For Russian And Ukrainian Planes," *Forbes,* December 8, 2021, accessed June 13, 2022, https://bit.ly/3xKpLeG

which are attack helicopters. [2]

Russian warplanes, flying at all hours of the day and night, aim to destroy Ukrainian radar stations and air defense systems with high-precision guided missiles. Russia's jets, for example, include the Su-35S, which has the best fourth generation features. This aircraft is armed with a 30-millimeter cannon. It can detect targets up to 400 kilometers away. Its radar can track 30 targets at the same time. Without refueling, the fighter's flight range is 3,500kilometers.[3]

According to the Russian Defense Ministry, squadrons of Su-35S combat aircraft (see Figure 1), in collaboration with Su-34 aircraft from the Russian armed forces' Western Military District, continue to strike Ukrainian military infrastructure facilities with precision-guided weapons. The ministry went on to say that during the "special military operation," they destroyed "the military infrastructure of the Ukrainian armed forces." The Russian Defense Ministry also claimed to have shot down two Ukrainian Su-25 bombers in Donetsk Oblast and Kherson Oblast in a single day.[4]

Figure 1: Russian Fighter SU-35S

Sources: *Rostec*.[5]

(2) "The Pilot Survey 2022," *Flight Global*, accessed June 13, 2022, https://bit.ly/3Mg7fzZ

(3) "Sukhoi Su-35S: Capabilities Out of This World," *Rostec*, accessed June 22, 2022, https://bit.ly/3QDRUvy. [Russian].

(4) "Russian Su-35 Fighter Jets Reportedly Bomb Ukrainian Targets," *Newsweek* May 23, 2022, accessed June 22, 2022, https://bit.ly/3nquIDy.

(5) "Sukhoi Su-35S: Capabilities Out of This World."

In addition, Russia possesses fifth generation fighter jets such as the SU-57 (see Figure 2), a multirole fighter jet capable of destroying all ground and air targets. It is known as a "radar killer" because of its superior ability to evade radar detection due to its coating which absorbs electromagnetic waves, making it one of the best in the world. It can also carry out electronic warfare against air and ground radars. It has a supersonic speed and can fly for long periods of time in any weather. Russian forces have announced that they are using aircraft in Ukraine to destroy the country's air defense network. The new Izdeliye 810 missile's performance has not been disclosed. However, the original R-37M can hit targets from a range of 200 kilometers.

The Su-35S is designed to gain air superiority by destroying manned and unmanned aerial vehicles over long, medium and short distances with guided missiles while performing long-range and short-range combat maneuvers.

Figure 2: SU-57 Stealth Fighter Jet

Source: Business Insider.[6]

Future wars will be fought with fifth-generation aircraft. They will pose a serious air threat to interceptor aircraft and ground

(6) "Russia›s much-touted Su-57 stealth fighter jet doesn›t appear to be showing up in Ukraine," Business Insider, June 14, 2022, accessed June 20, 2022, https://bit.ly/3nq451z.

air defense systems. This is due to their stealth technology, the small radar cross section (RCS) — which will help the jets evade radar detection — their electronic capabilities, and supersonic nature. This is in addition to their ability to launch simultaneous air-to-air and air-to-ground missile attacks.

Russia claimed in the early days of the war that it had carried out destructive strikes on the Ukrainian air force and air defenses, effectively paralyzing them. Experts predicted that Russia's powerful air force would play a significant role in ensuring a quick victory for Moscow. However, this did not occur entirely. The course of the war invalidated these predictions about the performance of Russia's air force , and many military analysts have been unable to explain why Russia has avoided to take air risks. Russia is undoubtedly still bombing from long distances, wreaking havoc. However, this bombing is not as accurate or effective as having war planes fly directly over the battlefield for extended periods of time. During the first weeks of the war, Russian forces were within 10 miles from the capital, Kyiv, and air raids were being carried out regularly. In many ways, life in the capital has returned to normal – shops are open, people are on the streets, and traffic jams are common, in contrast to the situation in eastern Ukraine. Russia may have achieved air control over parts of Ukraine's airspace at the start of the war, but it has been unable to impose air supremacy over the entire country. As the war escalated, Russia's plane losses increased due to the remaining anti-aircraft weapons in Ukraine. The United States and the UK also provided Ukraine with short-range surface-to-air missiles. In Syria, Russian forces obtained combat experience and demonstrated some ability to coordinate ground maneuvers with air attacks and drones. However, Russia was not confronted with interceptor aircraft or air defense systems owned by Syrian opposition factions.

According to some Western reports, Russia's relative failure in Ukraine is due to the large Russian fleet of aircraft not being properly maintained. Nor does Russia seem to have sufficient logistical support, fuel and spare parts to keep its planes flying

for longer periods over the theater of war. Furthermore, one of Russia's major issues is Ukraine's vast geographical area, which makes it a difficult and deep place to hit from the air. In addition, there are issues related to the Russians' poor air support training of the combat echelons of ground forces in combined arms warfare. It necessitates a high degree of decentralization and decision-making freedom for field commanders, which runs counter to the centralized nature of the Russian army inherited from the Soviet-era. Many columns of Russian troops, for example, were sent forward toward Kyiv without being reinforced by close air support. It is also claimed that, with the exception of elite pilots, Russian pilots have little experience with guided bombs and, as a result, rely heavily on unguided bombs. Furthermore, Russian capabilities in the field of jamming, monitoring, and countermeasures for surface-to-air missiles are inferior to those of the West.(7) Despite these Western allegations, Russian forces are said to be not that bad, and that Moscow was not necessarily willing to risk its aircraft and pilots, and that it is saving its best planes for any potential confrontation with NATO member countries. Therefore, Russia relies on missiles and artillery more than air forces. To avoid Ukrainian radars and shoulder-fired missiles that reached Ukraine from the United States, Latvia and Lithuania, Russian planes participating in the invasion flew limited and carefully planned sorties, often at low altitudes and at night.(8) The Pentagon continues to underestimate the capabilities of the Russian army, particularly its air capabilities. This is believed to be part of Washington's information war against Russia. As a result, some American lawmakers and analysts question the Pentagon's assessment. In a letter sent to President Biden in early March, a group of them stated that Russia had already demonstrated air superiority, and that if Ukraine did not receive military assistance, including additional anti-air defenses, this Russian air superiori-

(7) Jon Jackson, "Putin's Superior Air Force Is Failing Him in Ukraine," *Newsweek*, May 12, 2022 , accessed May 13, 2022, https://bit.ly/3Pkf35B
(8) "The Secret of Russia's Confused Air Force Performance in the Ukraine War," *Arabic Post*, April 12, 2022, accessed May 13, 2022, https://bit.ly/3MjGKJV. [Arabic].

ty could quickly turn into air supremacy.[9] Indeed, the Russian air force has increased its sorties by 50 percent since April, particularly in eastern Ukraine, which it considers a strategic priority at the moment. In fact, even if the Russians suffered some losses in their air fleet, they could completely destroy Ukraine with their air forces. But the Russians refuse to do so, possibly because they do not want to escalate the conflict from "limited military operations" to an "all-out war," which would broaden the scope of the Ukrainian crisis beyond Moscow's goals for this war. Perhaps Putin does not want to enrage the Ukrainian people by inflicting heavy losses on them, whether to later facilitate the Russian annexation of Ukraine or to install a pro-Moscow government which is not affiliated with NATO after toppling the current regime in Kyiv.

The Ukrainian Air Force and Air Defenses Come Under Russian Suppression Strikes

The Ukrainian air force was reported to have lost several aircraft during its brief air campaign against Russian-backed separatists in the Donbas in 2014 and 2015. The Ukrainian air force began the current conflict with approximately 125 fixed-wing warplanes, including approximately 30 Su-27 interceptors, 50 or so MiG-29 fighters, possibly 30 Su-25 attack aircraft, and approximately 12 Su-24 bombers. At the start of the Russian offensive, after bombing Ukrainian airports and planes stationed there with planes and missiles, neither the Ukrainian air force nor the air defenses were able to make any immediate tangible response.[10] It was noticeable that the Ukrainians lacked the necessary technical capabilities to repel the attack. They were, however, not completely taken aback by the Russian air attack, and they likely had foreknowledge of the time of the Russian attack due to prior US in-

(9) Dan Lamothe, "Russian Air Force Action Increases Despite Flood of Antiaircraft Missiles Into Ukraine," *The Washington Post*, March 22, 2022, accessed June 13, 2022, https://wapo.st/3zDVcZA
(10) David Axe, "Ukraine's Air Force Is Back! But Who Knows For How Long," *Forbes*, May 7, 2022, accessed May 12, 2022, https://bit.ly/3sxNyvv.

telligence support, at least at the strategic level. This would have allowed them to disperse and conceal some of their equipment and logistical supplies for later use in support of the resistance and to exhaust Russian forces. However, given the magnitude of Ukrainian air and ground defense losses, it can be said that the Russian army has largely neutralized Ukrainian air and defense capabilities**,** succeeding in the "shock and awe" military tactic yet it failed to launch a complete aborting airstrike. This is comparable to what occurred during the aborting Israeli air strike against Egyptian and Arab airports on June 5, 1967, after which the Israeli air force achieved complete air supremacy over all fronts after three-quarters of the Egyptian air fleet was rendered inoperable. According to the Russian narrative, the total military hardware destroyed since the start of what Russia calls a "special military operation" in Ukraine was 190 aircraft, 129 helicopters, 1,127 drones, 330 anti-aircraft missile systems, 3,424 tanks and other armored vehicles, and 473 missile launchers as of the end of June. There are 1,795 pieces of field artillery and mortars, as well as 3,446 special military vehicles.(11) If these figures are correct, they reflect the magnitude of Ukraine's losses as well as the enormous destructive power of Russia's air and missile capabilities. However, these Russian figures are thought to be exaggerated because they have not been confirmed by international reports. The number of aircraft owned by the Ukrainian fleet, according to the best estimates, does not exceed 125. How can Russia then claim to have destroyed 190 aircraft? Especially since we know that NATO member countries have yet to provide Ukraine with additional aircraft? Countries like Slovakia, Poland and Bulgaria are still looking into providing Ukraine with Soviet-made MiG-29 fighter jets. But these countries fear that the plan to supply these plans is fraught with risks, including escalating tensions between Russia and NATO. Russia may target these countries with harsh military responses at a time when these countries appear unprepared to defend their airspace against advanced Russian ballis-

(11) "Russian Defense Ministry Announces the Results of the Special Operation in Ukraine in a Single Day," *Russia Today*, June 6, 2022, accessed June 12, 2022, https://bit.ly/3NMC1AW. [Arabic].

tic missiles. Furthermore, without Russian supplies, post-Soviet hardware is unsustainable. Thus, Ukrainian air capabilities are limited. The Sukhoi 27, a single-seater, is its most advanced aircraft. Its most experienced pilots belong to a single two-squadron brigade. Its headquarters are in Myrhorod, Ukraine, east of the Dnieper River. Unlike the Sukhoi 25, which is designed for close air support of ground forces, the Sukhoi 27 is supersonic and equipped with air-to-air missiles. Even if we assume that the Eastern European countries supplied Ukraine with some of their Soviet aircraft such as the MiG-27 or MiG-29, the problem remains that Ukraine's radar stations are no longer operational.[12] If some of them are repaired, they will be destroyed by Russia right away. Thus, the Ukrainian planes will fly in a completely hostile airspace, with little chance of success in supporting the advances of the Ukrainian resistance or reaching their final destination without Russian air interception. This means the balance of air power with Russia will never reach equilibrium. Despite this scarcity of aircraft and aircraft guidance radars in Ukraine, since the beginning of May, the outdated and small Ukrainian air force is in a better position than it was at the start of the war. Ukrainian fighters were seen carrying out air attacks on border areas near the front line in eastern Ukraine's Donbas region. The influx of spare parts from Ukraine's allies may have aided in the repair of several aircraft. As a result, the Ukrainian air force has a number of operational planes. Ukrainian pilots use tactics such as flying at very low altitudes to protect themselves from Russian fighters and air defenses. For example, at the end of March, two Ukrainian helicopters struck a fuel storage facility in the border town of Belgorod, western Russia, without being detected by Russian radars, setting ablaze eight fuel depots. This indicates that Ukraine has recovered from the initial shock of the Russian military campaign. This is a promising sign which Ukraine will be eager to build on with continued Western assistance. Despite what has been said, there is no comparison between the air forc-

(12) Frédéric Beniada, "La Bataille du Ciel Ukrainien: Le Combat de David Contre Goliath?" *Franceinfo*, March 13, 2022, accessed June 14, 2022, https://bit.ly/3xuts6W. [French].

es of Russia and Ukraine. Unless NATO intervenes directly to upset the balance of power, a limited number of Ukrainian fighters will find it difficult to intercept Russian fighters or enter Russian depth, which is protected by a strong network of Russian air defense systems. Russia is thought to fly around 200 sorties per day so far, while Ukraine only flies five to 10.

Having Multi-Layered Air Defense Systems Is Critical in Wars

Limited Effectiveness of Ukrainian Air Defense Systems

Ground-based air defense systems safeguard military bases, critical state facilities, and residential communities. They also protect ground forces from air threats such as fighter jets, attack helicopters, unmanned aerial vehicles, and ballistic missiles.

During the Ukrainian war, Ukrainian air defenses did not provide complete protection. Their effectiveness against the Russian air and missile threat was limited. They did not carry out all of the aforesaid missions, which represented an abject failure. It is a lesson that must be remembered in today's wars, where fourth and fifth generation aircraft, drones and hypersonic ballistic missiles have all become sources of air threats that require sophisticated air defense systems to counter.

New generation aircraft, such as the MiG-35, F15, and F16, have appeared, each with high offensive capabilities, posing a significant threat to the state, its facilities, residents, and army.

Ukrainian air defense forces were not prepared to engage in an air battle with Russian air forces. They also had issues with their attack and interceptor aircraft, as well as with their ground-to-air defense systems. The most serious issues include: the equipment's' technical obsolescence, the inefficiency of those operating them, a lack of spare parts and their corrosion, and a lack of defense systems, especially since Ukraine is a large country that requires a large number of air defense systems to protect its cities and bases. In fact, the Ukrainian armed forces inherited large

quantities of air defense systems considered modern in the late 1980s and early 1990s from the Soviet army. However, it became clear after 30 years that they were not keeping up with the development of the offensive aspect of Russian air power.

According to official reports, Ukrainian air defense forces have 100 batteries of the Russian-made S-300 air defense system, which was developed during the Cold War and is capable of countering ballistic missile capabilities. Nonetheless, 40 of them have been destroyed by the Russian army since the start of its offensive on February 24 until the end of May. In fact, this system entered service in the Soviet army between 1978 and 1982, and its life span has nearly expired, and its combat effectiveness has deteriorated. Ukrainian military industrial facilities attempted to modernize and develop this system. However, the level of development was not convincing, as evidenced by the S-300 system's poor performance and the lack of combat readiness against Russian air and missile attacks, particularly at the start of the crisis. Field air defense systems like the Buk M1, USA-AKA-M and Strer-10 also experienced significant technical difficulties. The Ukrainian military leadership attempted to use the old Cop and S-125 systems, as well as the long-range S-200 system, but all attempts were largely unsuccessful.[13] Russia has access to the majority of these systems and is well-versed in their technical secrets, which means that they can, to a large extent, use electronic warfare methods against them to reduce their effectiveness in monitoring and interception.

Despite the statement by Ukrainian President Volodymyr Zelenskyy in the first week of May that Ukraine's military had shot down its 200th Russian aircraft, the figure cannot be independently verified.[14] Russia lost several planes. However, they gained the element of strategic surprise and were successful in achieving the first shock and suppressing Ukrainian air defenses, despite ef-

(13) "Debunking the Myth of Ukrainian Air Defense Effectiveness," *RT*, February 25, 2022, accessed April 11, 2022, https://bit.ly/3yrk9Ha. [Arabic].

(14) Greg Myre, "Ukraine Says It's Downed 200 Aircraft, a Mark of Russian Failures in the Sky," *WUSF*, May 16, 2022, https://bit.ly/3O5zGBf.

forts to rebuild them and use what was not destroyed from them, which were not in such large numbers. It does, however, highlight one of the more striking aspects of the war: Russian pilots are now more vulnerable than ever before, and they are hesitant to enter Ukrainian airspace. NATO recognized the imbalance in air power. In the third month of the war, both the United States and Germany supplied the Ukrainian army with 1,300 Stinger missiles. It is an anti-aircraft missile that uses ultraviolet radiation and is man portable. It has a 5-kilometer range and a height of 4,800 meters. The missile's warhead weighs 3 kilograms and is equipped with a proximity fuse. It travels at supersonic speeds.(15)

These missiles forced the Russians to limit air attacks by helicopters and fixed-wing low-flying attack aircraft to some extent. However, Russia compensated with missile and artillery bombardment, as well as fast planes that bombed from heights far and safe from the Stinger missiles' range. It is worth noting that the United States previously supplied these missiles to Afghan revolutionaries during the Russian invasion of Afghanistan. They were instrumental in the downing of hundreds of Soviet planes. In addition, the UK provided Ukraine with an unspecified number of Starstreak anti-aircraft missiles. Starstreak is one of the world's most advanced anti-aircraft missile systems. It is a high-velocity, short-range air defense system with a range of up to 7 kilometers and a speed of three times the speed of sound. This makes it the fastest short-range surface-to-air missile in the world. It has a warhead that can penetrate the target and explode inside it, ensuring total destruction. The missile also has a processor for detecting targets with an accurate guidance system. A Starstreak missile was seen hitting a Russian Mi-28N attack helicopter in video footage. The strike is thought to have taken place in the eastern Ukrainian regionofLuhansk.(16)

These short-range missiles, however, are designed for low-flying helicopters and fighters and are ineffective against Russian ballis-

(15)"Including Drones and Advanced Missiles…What Are Ukraine's Weapons Against Russia?" *Alaraby,* March 18, 2022, accessed May 12, 2022, https://bit.ly/3wlXUzM. [Arabic].

(16) Jack Buckby, "Starstreak, the Fastest Surface-to-air Missile Ever Made, Is Bringing Down Russian Helicopters in Ukraine," *Business Insider*, May 11, 2022, accessed June 14, 2022, https://bit.ly/3tyhnfO.

tic missiles and modern high-altitude aircraft. Furthermore, the number of Ukrainian air defense systems is still limited and cannot cover the entire country. They can only be deployed in a few cities, including the capital, Kyiv, and the second largest, Kharkiv. This has given Russia more leeway to conduct an increasing number of airstrikes around Mariupol, Ukraine's southern port city. So far, there have not been many Russian planes shot down near Mariupol. Ukraine understands that it cannot shoot down every Russian plane. So, it wants to use these short-range missiles wisely to make Russian pilots fearful that they could be targeted anywhere, forcing them to act defensively and reducing their air effectiveness and accurate ground delivery. Kyiv is also attempting to obtain more S-300 missiles, which are still very effective at hitting long-range air targets. The Ukrainians still have a limited supply and are well-versed in their use. It is mobile equipment that can be quickly deployed and easily concealed from Russian air strikes. Kyiv is attempting to obtain this missile system from countries that relied on the former Soviet Union and still have stocks, such as Poland, Slovakia, and Hungary.[17] In response, the US administration promised to assist Ukraine in acquiring longer-range air defense systems, such as shoulder-fired Stinger missiles and Starstreak missiles. However, talking about delivering these powerful anti-missile batteries to the Ukrainian army quickly is easier said than done. This is despite the fact that mobile anti-aircraft batteries, such as the THAAD or the Patriot, are ideal for this purpose. In recent years, the latter have proven to be extremely effective in Saudi Arabia against ballistic missiles and drones launched by the Houthi militia against civilian targets in the kingdom. However, the Ukrainian military has not been trained to use this advanced American weapon and using these systems on the battlefield takes several months. Furthermore, the number of these systems is limited, and it is difficult for the countries where they are deployed to abandon them and send them to Ukraine. The Ukrainian president hopes that Western countries will share satellite images or

(17) , Sébastian Seibt, "La Bataille du Ciel Ukrainien ne Passe Pas Forcément par une 'No-fly zone,'" *France* 24, March 17, 2022, accessed June 15, 2022, https://bit.ly/3tCPKT2 [French].

radar data with Kyiv in order to strengthen air defense against Russian aircraft and missiles. Western countries with very long-range radars can provide real-time aerial images to the Ukrainian army in order to provide early warning of approaching Russian missiles and aircraft for better air defense and faster response. But Washington is adamantly opposed. It is concerned that Russia will intercept communications, and the Pentagon does not want Moscow to learn about the sources of its satellite images or its capabilities in this field. The Ukrainian president has also called for a no-fly zone, but the West has so far refused due to geopolitical impossibility. This no-fly zone would allow NATO fighters to destroy Russian planes in order to enforce the no-fly zone, while the Russians will not hesitate to destroy NATO planes, potentially triggering a third world war which the West does not want.

Russian Air Defense Systems Are Powerful, But They Have Not Been Tested

Russia, for its part, has made significant investments in air defense systems. As a result, Russia now has some of the world's most advanced air and missile defense systems. The Russian air defense doctrine currently employs layered (tiered) air defense systems. This combat doctrine enables Russian air defense forces to construct highly impenetrable anti-access/area denial (A2/AD) systems. Long-range systems such as the S-200, S-300, and S-400 are used in the higher tiers of these defense networks, providing air defense circles with diameters of up to 800 kilometers. These tiers are usually supplemented by the second tier, which includes mid-range systems such as the SAM 11 system, also known as the 37 Buk-M1 9 systems, and its variants. This medium-range tier is designed to improve radar coverage within the air defense zone and replenish the limited stocks of medium-range interceptor missiles. The third tier employs short-range mobile systems such as the 9K33 Osa and S-125 Neva to provide additional protection for critical areas such as military bases or to keep up with ground forces' movements. These systems, along with mobile systems like the SAM 11, are frequently used to provide air protection to

ground force formations on the battlefield. Layer 1 and 2 defenses are frequently guarded by point defense systems such as the TOR or Pantsyr-S1.1 due to their vulnerability to low-flying threats such as cruise missiles.[18]

Until now, it has not been evident yet if Russia's air defense systems have faced a real test in the latest air battles by Russia or by the countries that have purchased them. Furthermore, so far in the Ukrainian war, Ukraine's air force has not entered Russian territory or launched ballistic missiles, so we cannot say whether the Russian air defense system is solid. It should be noted here that during the October 1973 war, the SAM-6, which was used by Egyptian air defense forces, proved to be effective against Israeli planes, shooting down over 50 Israeli planes.

Many military technology and weapons experts believe that Russia has the strongest air defense after the United States and may even outmatch it in some new categories, particularly with regard to the S-400 and S-500 missiles. The latter has a range of over 1,000 miles and is capable of intercepting all flying platforms, including missiles, planes, and drones. Some experts believe that these Russian missiles may be more capable than the American THAAD and Patriot missiles.

Conclusion

This war demonstrated that in modern warfare, securing multi-layered air defense against evolving air threats has become necessary to protect state facilities, military power, infrastructure, and civilians from any air threat. The Russians surprised the world by employing high-speed, maneuverable missiles that were difficult to detect, making it difficult for Ukraine's air defense forces to deal with them using conventional and aging air defense systems. This gave the Russians greater freedom of air action and air superiority over the war theater.

Despite Russia's air superiority, it cannot be claimed that Russia

(18) "Russian Air and Missile Defense," *Missile Threat*, August 3, 2021, accessed April 11, 2022, https://bit.ly/3wl906v

achieved total air supremacy during its invasion of Ukraine. Regardless of the reasons, whether technical or human deficiencies in its air performance, a desire not to deplete its air forces in anticipation of the war becoming prolonged or expanding the theater of conflict, Russia has not been able to completely eliminate all Ukrainian ground military units, target all Ukrainian military targets and combat positions, or disrupt Ukrainian resistance movement and work.

This war will serve as a catalyst for major countries such as the United States, Russia and China to develop air defense systems capable of dealing with this advanced type of air threat, which includes ballistic missiles, new-generation aircraft, and drones. Laser weapons are possibly one of the mediums that will be developed. Some countries, including China and Russia, have already begun developing laser weapons to counter various air threats. Russia claims to have anti-drone and anti-drone laser air defense weapons, as well as the ability to intercept satellites via the Peresvet system. The Russian army released videos featuring how this system could destroy Ukrainian Bayraktar drones in five seconds after firing laser beams at them.

Poly Technologies, a Chinese company, has developed a laser-based anti-drone air defense system called Silent Hunter. This system was on display at the International Defense Exhibition World Defense Show 2022, which was held in Riyadh in March of this year. According to one of the system's marketers, it is distinguished by its low cost, lack of ammunition consumption, and high capability to strike drones using lasers, regardless of their number or low flying altitude. It is being developed for use against ballistic missiles by the company. The system has an advanced laser and the ability to fire strikes and completely secure critical installations against drones. Saudi Arabia was the first country to sign a contract with the company to acquire a number of customized versions of this system. It was quickly integrated into the Saudi air defense system and used on the ground against Houthi drones launched against the kingdom. It was effective, according to users, and contributed to the downing of a large number of drones.

However, it is still in the experimental stage and is being prepared for the battlefield by connecting to the rest of the network and adding new system equipment.

Finally, in future wars, it must be considered that unless an air force is capable of imposing air supremacy over the theater of war prior to the start of ground operations, maintaining it throughout wartime and in all circumstances, and protecting the advance and maneuvering of ground columns, war may be a war of attrition and will be prolonged. The defending nation can reorganize its ground forces, equip them with anti-air defense weapons, and be reinforced with combat or drone aircraft to ensure freedom of ground maneuver, resulting in a gradual shift in the military balance of power. So, if the war lasts longer, will Ukraine rebuild and develop its air defense system with American and European assistance?