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Volodymyr KONOPKA
Candidate of Historical Sciences (Ph. D. in History),
Senior Officer of the Center of Military History
of the Armed Forces of Ukraine (Kyiv, Ukraine)
grafalf@gmail.com
https://orcid.org/0000-0003-0872-1833
Serhii TARANETS
Doctor of Philosophy,
Head of the Department of the Center of Military History
of the Armed Forces of Ukraine (Kyiv, Ukraine)
korsak111@gmail.com
https://orcid.org/0000-0002-0979-7496

COUNTERMEASURES OF THE DEFENCE FORCES OF UKRAINE AGAINST MEANS OF AIR ATTACK OF THE RUSSIAN FEDERATION (February 24, 2022 — February 28, 2023)

The aims to trace the nature of the use of the air attack means (means of air attack include ballistic missiles, heavier-than-air aircrafts — military aircrafts, helicopters, cruise missiles, aerial bombs, UAVs, and aerostats) by the Russian Federation during the first year of the wide-scale invasion of the Russian Federation into Ukraine, based on the analysis and comparison and to determine the countermeasures and anti-aircraft means used by the Defence Forces of Ukraine.

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The research methodology is based on the principles of historicism and impartiality and the use of comparative-historical and statistical methods. **Scientific novelty.** The data on the quantitative indicators of the means of the air attack of the aggressor — the Russian Federation and the information on the countermeasures against air attack means of the Russian Federation are introduced into the scientific circulation, the classification of the air defence systems and means of the Defence Forces of Ukraine, including those received by Ukraine within the framework of international military-technical assistance according to the principle of the phasing of acquisition and basic tactical and technical characteristics has been carried out. In **the conclusions** to the article, the effectiveness of the use of air attack means of the Russian Federation and the effectiveness of countering them by the Ukrainian air defence system, the intentions of the military and political leadership of the Russian Federation, and the chronology of air strikes, according to periodization and type are determined. The quantity of air defence complexes and means provided to Ukraine by the partner states and their impact on the conduct of hostilities are pointed out. Directions for strengthening Ukrainian air defence are outlined.

Keywords: *Russia's war against Ukraine, wide-scale invasion, Defence Forces of Ukraine, air defence, aviation, means of air attack, cruise missiles, ballistic missiles, UAV, international military and technical assistance.*

In 2024, Ukraine has been resisting for the third year, and its Defence Forces are repelling a wide-scale invasion of the Russian Federation into Ukraine. According to the accumulated information (reports, official statistical reports, interviews, etc.) and analytical data, it was possible to conduct a study of this period of the Russia's war against Ukraine, which has been ongoing since 2014. The actuality of the article is based on the low level of discovery of the problem by other researchers, as well as the need for a broader presentation of the results of the struggle of Ukrainian air defence units during February 2022 — February 2023. The main purpose of the article is to analyse and compare the available information on the potential of air attack means of the Russian armed forces and to trace the nature and methods of countering these means by the available forces and means of military units and air defence units of the Defence Forces of Ukraine.

Currently, the scientific development of the issues raised in the article covers a small list of scientific publications. By order of the Commander-in-Chief of the Armed Forces of Ukraine dated March 26, 2022, a military-historical commission was created in the Armed Forces of Ukraine to write a military-historical description of the Russia's war against Ukraine (from the beginning of the wide-scale invasion), which prepared the first issues of the description. The Military History Research Center of the Armed Forces of Ukraine has prepared 18 issues of the "Military-Historical Description of the Russo-Ukrainian War"; each of which deals with events that cover a calendar month (except the first issue, which covers the end of February — March 2022), during the preparation the article used the information from part of issues [1—12]. The article about the combat in the airspace of Ukraine during the first three months was prepared by scientists of the National Defence University of Ukraine V. Makarov and V. Rieznik [13], in which they summarized and systematized the experience of the use of aviation by the Armed Forces of Ukraine and the Russian Federation in the course of repelling wide-scale Russian aggression against of

Ukraine. A detailed analytical report on the missile attacks on Ukraine was prepared by Ian Williams, an employee of the international security program of the Center for Strategic and International Studies (CSIS), in which he attempted to trace military strategic plans, their implementation, and changes that occurred during the Russian air strikes during the first 12 months of a large-scale invasion [14].

The source of the research is based on statistical data published on official platforms of state sites of Ukraine, as well as in the media. It is worth pointing out that publishing certain data available to the authors is prohibited due to martial law; therefore, only the information from open sources was used.

The potential of the air attack means of the Armed Forces of the Russian Federation

The experience of conducting hostilities during the wide-scale invasion of the Russian Federation into Ukraine proved that one of the most important elements of the enemy attack was the use of aviation, cruise and ballistic missiles of air-based, sea-based, and surface-based, guided aerial bombs and long-range unmanned aerial vehicles.

Cruise missiles (CM [1]) — are small-sized targets that operate at low and extremely low altitudes and are effective, high-precision means of hitting various military facilities and infrastructure. They are made according to the aircraft scheme, and aerodynamic lifting force is used for flight. There is also a peculiarity that the launches were carried out in zones, in the absence of active countermeasures by the anti-aircraft means of the opposing side. CM can be classified by types: by purpose (strategic — more than 500 km, operational-tactical — 150—500 km, tactical — up to 150 km); by the place of launch and location of the object of impact (air-to-air CM, ground-to-ground CM, air-to-ground CM). CM has certain advantages compared to other means of attack; among them, we can highlight in particular, the range of use, the possibility of flying at extremely low altitudes, a low level of thermal radiation, the possibility of a programmed manoeuvre (inertial guidance system) and a small effective dispersion surface.

Ballistic missiles (BM) — are a type of missile that flies on an unguided ballistic trajectory. The armed forces of the Russian Federation used short-range (up to 1,000 km) and medium-range (up to 2,500 km) BM. An effective system of combating BM and CM includes such components as:

1) neutralization and destruction of carriers and launchers;

[1] Below is a list of abbreviations: BM — ballistic missile, UAV — unmanned aerial vehicle, MCDS — mobile coastal defence system, MTA — military-technical assistance, SAM — a surface-to-air missile, SAMs — surface-to-air missile system, AF — Armed Forces, CM — a cruise missile, MFG — mobile fire group, SMS — small missile ship, JFO — Joint Forces operation, OTMS — operational-tactical missile system, MANPADS — man-portable air-defence system, ASF — Air and Space Forces, AD — Air Defence, AF — Air Force, MC — missile complex, RS — radar station, RT — radio-technical troops, ELINT — electronic intelligence, SPAAG — self-propelled anti-aircraft gun, ROTU — russian occupied territories of Ukraine, TMS — tactical missile system.

2) destruction of missiles using air defence during flight;

3) measures to prevent damage from missile attacks.

According to available information from open sources, 1,600 missiles of various types were manufactured (prepared for operation or modernized) in the Russian Federation during 2022 [15, P. 41].

Since the beginning of the wide-scale invasion of the Armed Forces of the Russian Federation, they used three types of missile systems (launch platforms) for air strikes:

1. *Surface-based*: for launching ballistic missiles — TMS "Tochka/Tochka-U" (missiles: 9M79/9M79M), OTMS "Iskander-M" (missile: 9M723 [2]); for launching cruise missiles — OTMS "Iskander-K" (missiles: P-500/9M728 and 9M729 [3]), MCDS "Bal" (missiles: Kh-35 "Zvezda" [4]), MCDS "Bastion" (missiles: P-800 "Oniks" [5], Kh-61 "Jakhont"); for launching anti-aircraft guided missiles — SAM S-300/S-400 (missiles: 9M83, 9M82, 5B55, 48H6, 9M96).

2. *Subsurface based*: for launching cruise missiles — MC "Kalibr" [6] (missiles 3M54 and 3M14). Carriers of MC "Kalibr" — submarines: project 877, 633; ships: frigates of project 22350, 11356; missile boat 1241; corvettes project 20385; small artillery ships of project 21631; patrol ships project 22160.

3. *Air-based*: for launching aviation cruise missiles — Su-24M, Su-27, Su-30, Su-34, Su-35, Tu-22M, Tu-95, Tu-142, Tu-160, MiG-29 (missiles: Kh-31, Kh-32, Kh-55, Kh-58, Kh-101, Kh-102, Kh-555, Kh-22 "Storm", Kh-59 "Ovod"); for launching aeroballistic missiles — hypersonic aviation missile complex Kh-47m2 "Kinzhal", from launch platforms placed on the MiG-31K and Tu-22M3 (missiles: 9-C-7760/ Kh-47) (see fig. 1).

In the first days of the wide-scale armed aggression of the Russian Federation against Ukraine, the primary targets of the occupiers were objects of control facilities (headquarters, command posts, and reserve command posts), positions of radio engineering and anti-aircraft missile units, tactical and transport aviation airfields, ship bases, and arsenals (storage bases) and military equipment warehouses, weapons, ammunition, and fuel. During the first months of the wide-scale invasion, further to the above, the aggressor carried out missile and bomb attacks on Ukrainian critical infrastructure facilities, logistical support facilities and routes, and troop deployment and deployment areas.

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[2] Quasi-ballistic, with a correlation guidance system.

[3] Made based on "Kalibr-NK".

[4] A turbojet missile that can be launched from a MCDS, aircraft, helicopters, and surface ships.

[5] A supersonic universal missile, the launch of which was carried out from MCDS, ships, and submarines.

[6] There are several modifications of the MC "Kalibr" cruise missiles, so we provide the index of the class of missiles depending on the launch platform: S — submarine; SH — surface ships; M — mobile missile complex, A — air-based, C — container complex. Cruise missiles can be divided by purpose: anti-ship missiles — 3M54, for ground targets — 3M14. Missiles have the corresponding index for weapons: T — ships, K — submarines, E — mobile missile complexes, A — aviation.

Type of missiles	Estimated number in service 24.02.2022	Carrier / rocket launcher	Amount of carriers and rocket launchers
Air based			
X-55SM / X-555, X-101 /X-102	450 (+800 in reserve)	Tu-95MS/MSM	64
		Tu-160	16
X-22 / X-32	400 (+in reserve)	Tu-22M3	61
Kh-47M2 "Kinzhal"	50+	MiG-3 IK	12
Kh-29, Kh-31P, Kh-35U, Kh-58, Kh-59MK2	500 (+in reserve)	Su-30SM	113
		Su-34	112
		Su-35	99
		Su-27SM/SM3	45/24
Surface based			
9M728/9M729	100+	OTRK 9K720 "Iskander-M(K)"	162
9M723	800+		
3M55 (P-800) "Oniks"	500+	BRK "Bastion"	56
9M79	1500+ (in reserve)	TRK 9K79 "Tochka-U"	50
5B55	8000+	SAMs S-300 "Favorit"	496
48N6DM	2000+	SAMs S-400 "Triumph"	448
Based in the sea			
3M-14T "Kalibr"	500+	MRK project 21631	10
		Frigates project 11356P	4
		Submarines project 877	21
Kh-35U	300 (+in reserve)	Patrol ship project 01090	1
		Corvette project 1241	20

Fig. 1. Estimated number of missiles in service with the Russian Federation in February 24, 2022

For example, here, approximate quantitative indicators of the use of some types of missiles and attack UAVs by the Russians and their damage by Ukrainian air defence systems and means are provided. The total number of cruise and ballistic missiles used by Russia in the specified period (February 2022 — February 2023) is more than 4,000 (see fig. 2).

During the period from February 24, 2022, to February 28, 2023, the forces and means of air defence units of the Armed Forces of Ukraine destroyed cruise missiles (out of the total number used): Kh-101/Kh-555 — 560 (71.8 %), 3M14 "Kalibr" — 240 (40 %), 9M728 "Iskander K" — 11 (40.7 %). However, cruise missiles of the Kh-22/Kh-32 and 3M-55 "Oniks" types, as well as 9M723 "Iskander M" ballistic missiles and surface-to-air missile systems upgraded to the "surface-to-surface" version 5V55/46H6DM, aeroballistic Kh-47M2 "Kinzhal" — Ukrainian air defence units were not shot down. Of the total number of CM released by the Russians (1,777 units), 811 units were neutralized. (45.6 %). Units of other types of troops of the Defence Forces of Ukraine hit an additional 62 missiles [12, P. 146].

During the year, the Russians launched more than seven hundred UAVs of the operational-tactical level and about 680 strikes "Shahed 131/136" during September 2022 — February 2023, of which 1,090 were hit by air defence systems of the Air Force of the Armed Forces of Ukraine (78.4 %). Another 961 UAVs of various types were additionally shot down by other units of the Defence Forces of Ukraine [12, P. 145]. The most effective means of combating Russian-made "Lancet" and "Kub", Iranian-made "Shahed-131" and "Shahed-136" kamikaze drones were SAMS "Gepard", MANPADS "Stinger", "Starstreak", "Strela", "Piorun".

It is worth emphasizing that due to the effective performance of the Ukrainian forces and means of air defence units and aviation, the aggressor was forced to stop using manned aircraft over the territory controlled by the Defence Forces of Ukraine. He had to move planes and helicopters to safe distances beyond the reach of Ukrainian weapons. The Ukrainian air defence system limited the capabilities of the Russian tactical aviation, which began to operate mainly in tactical depth along the battle line.

Since February 24, 2022 until February 28, 2023, the Armed Forces of Russian Federation lost about 300 aircraft: in February — 29, March — 106, April — 55, May — 18, June — 9, July — 6, August — 11, September — 30, October — 11, November — 5, December — 3, January 2023 — 10, February 2023 — 7 [12, P. 145]. Dynamics of losses of enemy helicopters during the same period — 288 units: February — 29, March — 102, April — 24, May — 19, June — 11, July — 5, August — 14, September — 21, October — 28, November — 8, December — 8, January 2023 — 15, February 2023 — 4 [12, P. 145].

The propaganda of the Russian Federation on the eve of the wide-scale invasion had a significant impact on the public consciousness, spreading information that the Armed Forces of the Russian Federation is one of the strongest in the world (especially its air and space forces), listing the "most powerful" models in their opinion: the latest 5th generation Su-57, generation 4++ — Su-35S, Su-30SM3, Su-34, modernized versions of Su-27, Su-24M, Su-25, modernized anti-aircraft missiles

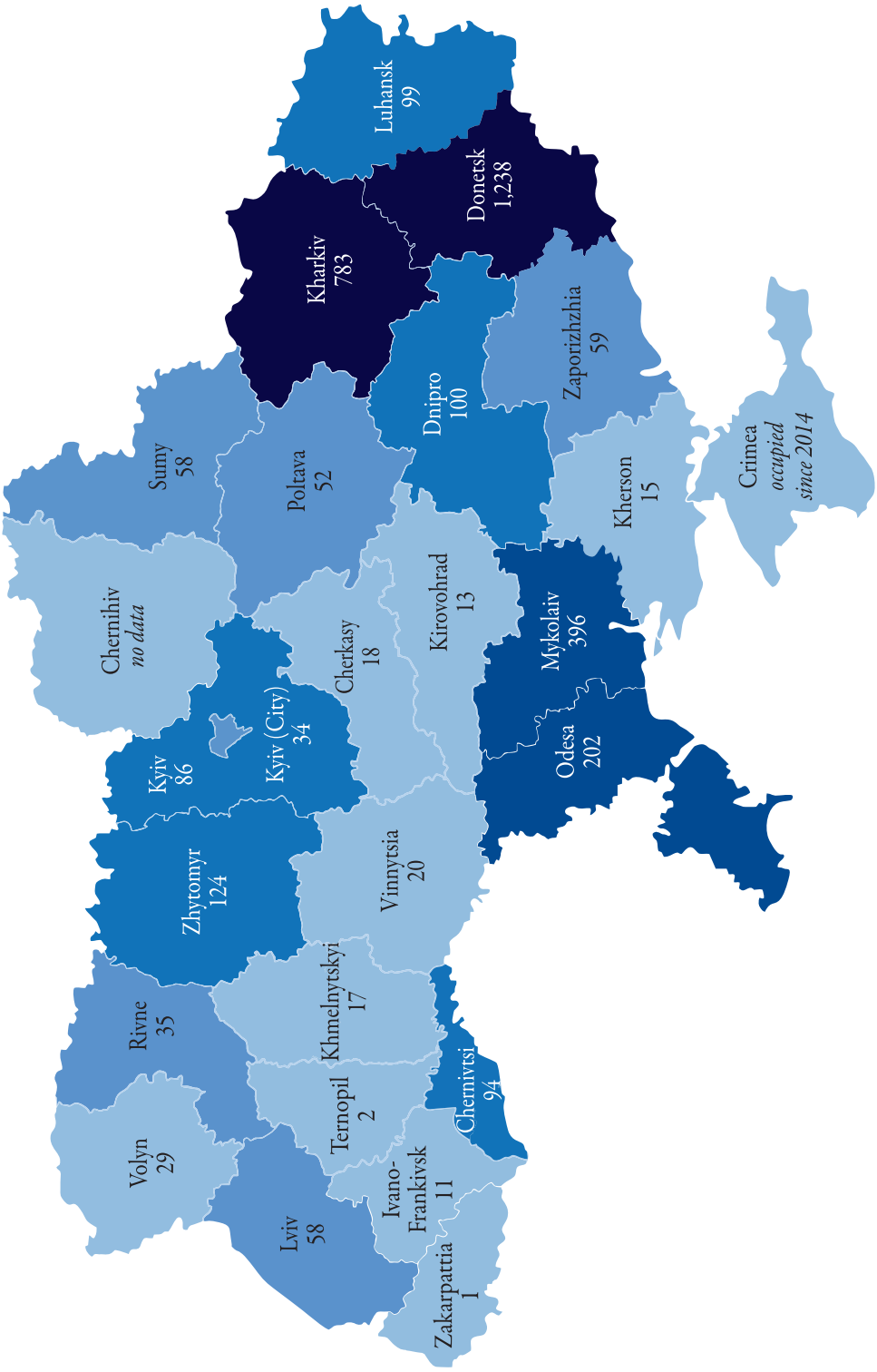

Fig. 2. Missile strikes of the Russian Federation in regions (February, 24 — July 21, 2022) [14, P. 18]

46H6DM, high-precision missiles: cruise missiles Kh-555, Kh-101, 3M14 "Kalibr", 9M728 "Iskander K"; ballistic missiles 9M723 "Iskander M"; aeroballistic Kh-47M2 "Kinzhal", anti-ship supersonic universal P-800 "Oniks" [1, P. 26—27].

After February 24, 2022, the Defence Forces of Ukraine had to actively counter the listed examples of the aggressor's air attack. Effectively using the air defence complexes and means which were at their disposal to intercept the Russian means of air attack, during the first months of repelling the wide-scale invasion, it became clear that the number of declared samples of new modern weapons at the disposal of the occupiers was not as large as the Russians political figures and propagandists claimed.

Another element of Russian propaganda was the "great experience" gained during the combat actions in Syria. However, this also did not correspond to the real state of affairs; in particular, Ukrainian military experts characterized the acquired practical experience of Russian aviation in Syria as follows: "The strikes on ground targets took place in the absence of the enemy's anti-aircraft system. Fighter pilots did not gain experience in aerial combat due to the lack of an aerial enemy. Combat tasks were usually carried out by small forces — from a single aircraft to a unit, which did not allow the Russian command to gain experience in managing large aviation forces while conducting a full-fledged modern air (air-ground) operation, planning and launching massive missile-aircraft and radio-electronic fire strikes. Thus, the Syrian experience does not correspond to the conditions of conducting an armed struggle in the air during a high-intensity conflict" [1, P. 38—39].

During the first months of the wide-scale aggression, the Russian Air Forces gained combat experience and made certain changes in the tactics of using air attack means. Thus, to complicate the detection of aerial targets by Ukrainian radio engineering and anti-aircraft missile units, the occupiers often used different directions and altitude ranges of missile launches, and different flight routes , turning coordinates, and course corrections (if necessary) were programmed for each of the CM. The second innovation concerned launching missiles without the use of appropriate voice commands or even in radio silence mode, which made it difficult to detect targets in time by Ukrainian RT means. Since May 2022, the occupiers began to use less accurate long-range Soviet-made supersonic anti-ship air-launched missiles — Kh-22/Kh-32, which were launched from high altitudes (approximately 12,000 meters), which limited the capabilities of Ukrainian means of RT in the ability to fix them at the time of launch.

The Defence Forces of Ukraine, while assessing the possibility of detection by RT and hitting with SAM means and damage by air defence systems, as well as by mobile fire groups (hereinafter referred to as MFG), armed with MANPADS and large-caliber machine guns, had to consider the characteristics of each of the types of cruise missiles used by the Russians. At the beginning of the wide-scale invasion, the effectiveness of Ukrainian air defence in intercepting enemy air targets was about 10 %; in the summer of 2022 it was about 30 %; at the beginning of autumn 2022 it increased to 50 %, and in November 2022, this indicator was already about 80—90 %. Indicators of the effectiveness and combat capabilities of the Ukrainian air defence system have significantly increased due to the provision of air defence systems and means to Ukraine by partner states within the framework of international military and technical assistance (hereinafter referred to as MTA).

Chronology of anti-aircraft combat of the Defence Forces of Ukraine (see fig. 3)

Stage I: Strategic air strike (offensive) (February — March 2022)

Only in the first two days of the wide-scale invasion, the occupiers carried out more than 160 air and missile strikes on the territory of Ukraine, focusing their efforts on airfields, airports, aviation fuel warehouses and ammunition storage facilities, stationary air defence facilities [14, P. 5].

On February 24, 2022, about 8 missiles were struck at the Ozerne military airfield in the Zhytomyr region, as a result of which two Su-27s were destroyed/damaged on the ground [16]. At the same time, an airbase in the Ivano-Frankivsk region was struck — six MiG-29s that were in storage were damaged [17]. It was fixed on satellite images that two Su-24 fighter bombers were destroyed at the Lutsk air base [18]. In the village Lypetske, Podilsky district, Odesa Region, a military unit, where the radar system Company of the 14th Radio Engineering Brigade of Operational Command "South" of the Armed Forces of Ukraine was stationed, was hit by a rocket attack — 22 people were killed [19]. Missile attacks were carried out on the infrastructure of air bases and airfields — in Vasylkiv and international airport Boryspil (Kyiv region), Novyi Kalyniv (Lviv region), Chuhuiv (Kharkiv region). On February 25, missile attacks were carried out on air bases in Starokostiantyniv (Khmelnytskyi region), Kulbakino (Mykolaiv region), and Myrhorod (Poltava region). On February 27, 2022, a 9M723 "Iskander" missile destroyed the fuel storage tanks at the air base in Vasylkiv [1, P. 51—52]. On the same day, several 9M723 "Iskander" missiles attacked the airport in Zhytomyr [14, P. 37]. Russian Su-30, Su-35, and Su-34 fighter bombers hit Ukrainian radio-electronic systems and air defence equipment (mainly radar stations) with Kh-31P anti-radar missiles (PD) with passive radar [13, P. 21].

The attempts of the occupiers during the first months to destroy (suppress) the Ukrainian air defence system and aviation to gain dominance in the airspace — were in vain. As a result, Russian losses of aviation assets as of April 30, 2022, amounted to 190 aircraft, 155 helicopters, and 232 UAVs of operational-tactical level [2, P. 35].

If we compare the ratio of the aircraft fleet of the opposing sides, on February 24, 2022, according to the "World Air Forces 2022" guide from Flight Global, Ukraine had 202 aircraft and 122 helicopters, while the Russian Federation had 2,543 aircraft and 1,665 helicopters. The indicated data provide an understanding of the ratio of Ukrainian and Russian manned aircraft in the arms of the opposing parties, which was 1:13, respectively [20, P. 28, 32]. As a result of the significant numerical superiority of Russian aircraft, aerial battles took place in the sky over the Ukrainian capital from the first days of the wide-scale invasion. At the same time, Ukrainian planes and helicopters were actively involved in the battles for the airfield in Hostomel, inflicting damage on the multi-kilometer columns of the occupiers, providing air cover and support to the ground units of the Defence Forces of Ukraine [14, P. 6].

There were the following long-range SAMs among the ground air defence equipment in Ukrainian units and at storage bases, at the time of the invasion — S-200B,

Settings	Periodization of repelling Russian aggression against Ukraine				
Periods of full-scale war	**Preparation period** (December 2021 — February 23, 2022)	**1 stage.** The first strategic defense operation (February 24 — April 2022)	**2 stage.** The second strategic defense operation (May — August 2022)	**3 stage.** The first strategic offensive operation (September — November 2022)	**4 stage.** The third strategic defense operation (December 2022 — February 2023
Periods of use of air attack means		**I stage** Strategic air strike (offensive) (February — March 2022)	**II stage** Damage to the economic and industrial potential and logistical support (April — September 2022)	**III stage** Strategic attack on the facilities of the United Energy System of Ukraine (October 2022 — February 2023)	
Air attack priority targets of the Russian Federation		• Airfields for basing aircraft • Positions of air defense units (RTT, MT) • Arsenals, warehouses, bases, places of storage of ammo, fuel, MT and other military property • Places of placement, deployment and training of military units • Management facilities (headquarters and command posts)	• Defense industry Civil industry Logistic support (railway infrastructure facilities, road overpasses, bridges)	Energy system of Ukraine	
		• Front-line support by means of air attack of troops (forces) in tactical depth along the battle line			

Fig. 3. Chronology of anti-aircraft combat of the Defense Forces of Ukraine

medium-range — S-300B1 (6 units), S-300PT/PS (201 units), S-300PMU (8 units), short-range — Buk-M1 (72 units), "Tor", S-125 "Pechora-2D" (8 units), short-range — "Tunguska" (75 units), "Osa-AKM" (30 units), "Strela-10" (75 units), ZSU-23-4 "Shilka", ZU-23-2, S-60, Igla-1M, Strela-2MM, "Strela-3" [21, P. 84—90]. MiG-29 (51 units) and Su-27 (33 units) aircraft were also involved to counter the missile strike.

The use of the airspace and border areas of Belarus with Ukraine, in addition to the territory of the Russian Federation itself, contributed to the expansion of the capabilities of Russian troops to launch missile and air strikes on the entire territory of Ukraine, especially its western part. From the beginning of the wide-scale invasion until the end of April 2022, about 631 missiles of various classes were launched from the territory of Belarus over Ukraine [2, P. 31]. In April 2022, at one of the briefings, the self-proclaimed president of Belarus, O. Lukashenko, confirmed that airstrikes were carried out and continue to be carried out on Ukraine from the territory of his country. This, once again, and at the official level, confirmed the statement of Ukrainian official representatives — Belarus is also responsible for the destruction and casualties among the civilian population of Ukraine and is a co-aggressor of the Russia's war against Ukraine. The same information was confirmed by the evidence provided to the US government by the leader of the Belarusian opposition S. Tykhanouskaya, who stated: *"This is massive evidence of the launching of missiles from our territory, the movement of Russian equipment on the territory of Belarus. This is internal information about some internal orders on the placement of various Russian military equipment on our territory"* [2, P. 18—19].

In the second half of April 2022, the ASF of the Russian Federation intensified missile and air strikes throughout the territory of Ukraine, focusing not only on military targets but also on civilian targets in large cities (Kyiv, Lviv, Dnipro, Kremenchuk, Mykolaiv, Rivne, Uman, Kharkiv, and others). The enemy's missile strikes were primarily aimed at disrupting the logistical support of the Defence Forces of Ukraine (railway stations and bridges, fuel storage facilities and oil refineries, weapons, and military equipment warehouses, airfields, etc.) [3, P. 94]. As part of the air support of the troops, Russian aviation carried out missile and bomb attacks in almost all directions, and the average intensity of its use was 150—170 flights per day. At the same time, as a result of the massive saturation of Ukrainian units with foreign-made MANPADS, the active and quite effective countermeasures of Ukrainian air defence, the occupiers reduced the intensity of the use of helicopters.

As a result of the depletion of high-precision missile reserves, which were calculated for a short-term strategic operation and to increase the ability to inflict fire damage at a range of up to 120 km and to increase the effectiveness of counter-battery warfare, the occupiers began to massively return to service decommissioned missiles from April 2022 TMS "Tochka-U" capable of hitting a wide range of targets with high-explosive fragmentation and cluster warheads weighing up to 480 kg. The occupiers used this complex for striking civilian objects, such as the hospital in Vugledar, the residential quarters of Mariupol, Avdiivka, and other front-line cities [22—28]. The task of a targeted attack on the railway station of Kramatorsk on April 8, 2022,

when the enemy used a 9K79-1 cluster rocket of the Tochka-U TMS, gained the greatest resonance. The goal was to kill as many civilians as possible (there were more than 1,000 people at the station) who wanted to evacuate. A few days after that (April 14), a missile from "the Tochka-U" missile defence system hit the city of Horodnia [2, P. 50]. Considering the threats posed by such tactical missile complexes, including to the civilian population, the air defence units of the Defence Forces of Ukraine had to intercept missiles of this type as well (there were even cases of interception by MANPADS launchers) [2, P. 38—39, 115].

Therefore, it is possible to state the fact that, in addition to hitting military targets, the Russians widely used the means of air attack against Ukrainian civilian objects and the population. The purpose of this kind of terror and intimidation of the civilian population was to create conditions that would make life impossible in the cities, stimulate the departure of the Ukrainian population outside the country, increase the discontent of the civilian population in the rear, and put pressure on the authorities through the formation of protest moods to make decisions regarding the immediate cessation of resistance on the terms of the aggressor country.

The Russian missile strikes at the strategic level did not achieve results, but they caused the death and injury of many civilians — it was mainly the civilian infrastructure that was damaged. Having not achieved a clear result of the destruction of aviation and neutralization of air defence of the Defence Forces of Ukraine, the Russian Federation directed its efforts to the use of air attack means on objects of industry (both defence and civilian), energy (fuel storage bases, substations, power lines) and transport infrastructure (railways junctions, railway stations, road, and railway bridges). The launching of missile attacks on the Territorial centres of recruitment and social support and training grounds should also be highlighted, the purpose of which was to slow down the process of conducting mobilization activities, military training, training, and settlement of newly formed Ukrainian military units and units.

To carry out massive airstrikes in the first months of the wide-scale Russian aggression, the Air Force of the Russian Federation used a tactical formation of aviation orders, which included a strike group (up to a link consisting of Su-24M, Su-25, Su-34, Tu-22M3) and a cover group (up to four Su-30 and Su-35). At the same time, A-50 long-range radar detection and control aircraft and Il-22 jammers were constantly on combat duty over the territory of the Republic of Belarus and the Russian Federation. In the border areas with Ukraine, the Russians simultaneously used the Su-35, which was at an altitude of more than 10 km, tracking the airspace at a distance of up to 200 km. Its task was to detect Ukrainian aircraft in the airspace and relay combat control commands for his strike tactical group. Considering these threats and the enemy's active use of radio-electronic warfare, Ukrainian pilots flew at low and extremely low altitudes to preserve their aircraft.

An important element of Ukrainian air defence during the repulse of Russian aggression was the work of radio technical intelligence units, which consisted of establishing the system of radio intercepts and radar detection of tactical groups of enemy aviation and other air targets. The use of the "Virazh-tablet" equipment made it possible to reduce the time indicators of alerting the Ukrainian aviation and

surface-to-air missile units (about 8-10 minutes), which made it possible to prepare air defence complexes and means for combat work in a shorter time. The Ukrainian radio-technical units systematically manoeuvred their forces and assets and constantly redeployed radio-electronic means and equipment to increase effectiveness and survivability. During radar reconnaissance, a manoeuvre was carried out in the frequency range of the radar field, which was achieved due to the use of radar "M" of the wave range (P-18 "Malakhit", 5H84A(MA)) — to create another radio electronic field; radio location system "SM" of the wave range (P-37, 79K6) and "DM" of the wave range (19Zh6, 35D6(M)); radio altimeters (PRV-13, PRV-16(MA)) — for radar support of combat operations. Special operation modes of different frequency ranges radars were used to protect against enemy anti-radar missiles.

Mobile fire groups armed with MANPADS and large-caliber machine guns (DShK, NSVT, M2 Browning) are an integral part of the organization of anti-missile and anti-drone combat. The integration of such air defence systems into the anti-aircraft missile defence system, supplemented by MANPADS calculations, made it possible to create a rather extensive and effective network of countermeasures against Russian means of air attack.

II stage: Impact of economic and industrial potential and logistics support (April — September 2022)

Starting from the end of April 2022, medium- and long-range cruise and aero-ballistic missiles were used by the enemy against separate groups of targets — civilian fuel storage bases, railway and hydraulic infrastructure, defence industry facilities, and civilian buildings. Thus, in the spring and summer of 2022, there was a transition to deliberate and systematic strikes on critical infrastructure and objects of mixed and even purely civilian purposes. At the same time, strikes on military facilities continued with less intensity than in February-April 2022.

The search for new approaches in the use of missile weapons was accompanied by the expansion of the range of air attack means. Thus, since April 30, 2022, the enemy began using supersonic universal cruise missiles 3M55 (P-800 "Oniks") of the Bastion missile defence system in the south of Ukraine, and since May 8, 2022 — supersonic long-range air-based anti-ship cruise missiles Kh-22/Kh-32 from Tu-22M3 carrier aircraft. The latter, having low accuracy indicators (more than 200 m), immediately turned into a tool of terror — already on May 9, they struck the Riviera shopping and entertainment center in Odesa, and on June 27, they struck the Amstor shopping center in Kremenchuk, which was accompanied by dozens of victims among the civilian population [4, P. 18].

On July 8, the head of the Mykolaiv regional military administration, Vitaly Kim, for the first time, made public information about the enemy's use of modified anti-aircraft guided missiles 5V55 of S-300 complexes for strikes on ground objects. Considering rather low accuracy indicators of such missiles (converted to hit ground targets) and with this method of their use, they also turned into a tool of terror [5, P. 70, 71, 127; 14, P. 9].

The use of cruise, aero ballistic, and surface-to-surface guided missiles on the territory of Ukraine was not always determined by military considerations. In seve-

ral cases, this could be a component of information warfare and used as content important for Russian media in response to the successful actions of the Defence Forces of Ukraine. In particular, in response to the liberation of Zmiinyi Island by the Ukrainian troops on June 30, accompanied by the well-known statement of the spokesman of the Ministry of Defence of the Russian Federation about a "gesture of goodwill", on the night of July 1, the occupiers launched a rocket attack, as a result of which there were hit a block of flats and a recreation center in the village Serhiivka (Bilhorod-Dnistrovskyi district, Odesa region) — 21 civilians died [5, P. 69].

After receiving a devastating defeat of the occupying forces of the Russian Federation in the North-Western operational zone, suffering significant losses near Kyiv, and the transition of a large-scale war into a protracted phase, the military and political leadership of the aggressor country was forced to adjust its plans. From attempts to neutralize or liquidate the Ukrainian political and military leadership and damage the critical infrastructure and economic potential of Ukraine through the use of high-precision missiles, the enemy was forced to focus its main efforts on mastering the territories of Donetsk and Luhansk regions and concentrate on hitting certain groups of targets in the deep rear with the entire range of missile weapons Defence Forces of Ukraine.

In turn, the Defence Forces of Ukraine actively continued to use the anti-aircraft weapons available. To strengthen the combat capabilities and restore, as a result of the losses, the potential of the Ukrainian air defence units, intensive measures were taken to remove air defence complexes (S-300, S-300B1) and aviation equipment (MiG-29) from storage and bring them to a combat condition. The Defence Forces received air defence equipment of the Soviet model (launchers of the S-300 complex and their missiles), as well as large volumes of Western-made MANPADS ("Piorun", "Stinger", "Mistral" and others) from the partner states within the framework of the international military and technical support [21, P. 213—214]. Considering the acquired capabilities and based on the results of the analysis of the enemy's use of air, subsurface, and surface-based missiles, the Ukrainian air defence system has become more extensive and effective.

In this (spring-summer) period, fighter aircraft of the Armed Forces of Ukraine with air-to-air missiles and MANPADS were widely used to repel massive missile strikes, and the widespread use of MVG proved to be highly effective.

Stage III: Strategic attack on the facilities of the United Energy System of Ukraine (October 2022 — February 2023)

The period from September to the first half of October 2022 is characterized by attempts by the Russians to use long-range missiles to damage the energy infrastructure of Ukraine. The aggressor aimed to undermine the general ability of Ukrainians to resist and reduce the level of defence capability of Ukraine as a whole by reducing the general standard of living and the moral and psychological state of the population as a result of the destruction of a critically important energy structure in the autumn-winter period, which is a violation of international humanitarian law and is regarded as a war crime (see fig. 4).

SAMs anti-aircraft defense medium range	FSAF "SAMP/T", S-300 PMU
SAMs anti-aircraft defense short range	"Spada/Aspide", S-125 "Newa" SC, NASAMS, IRIS-T SLM, MIM-23 "HAWK"
SAMs anti-aircraft defense close range	"Martlet", "Piorun", "Crotale", "Stormer" HVM, "Starstreak", AN/TWQ-1 "Avenger", "Mistral", "Stinger", RBS 70, "Skyranger 35", "Gepard", "Viktor", Bofos L70, 23 Itk 95, "Zastava" M55, "Zastava" M75, 9K32 "Strela-2", 9K34 "Strela-3", 9K32M "Strela-2M", Osa-AKM-Pl "Żądło", 9K33 "Osa", ZSU-23-4 "Shilka", S-60
Radiolocation stations	AN/MPQ-64 "Sentinel", TRML-4D, SQUIPQ Ground Surveillance Radar, PS-90 "Giraffe-75", AN/MPQ-65, AN/TSQ-288, 36D6M

Fig. 4. Missile strikes of the Russian Federation in regions (February 24 — July 21, 2022) [14, P. 18]

As a result of the massive and intensive use by the Russians of air attacks on the territory of Ukraine, the reserve of high-precision cruise missiles at the end of August — the beginning of September 2022, in general, was about 45 % of the amount that was accumulated before the invasion on February 24, 2022, and the reserve of high-precision cruise missiles of ballistic missiles decreased to 20 % [6, P. 125]. According to some types of high-precision missiles (especially ballistic ones), their stocks fell below the indicators of intact stocks (30 %), and in general, almost the entire line of high-precision missiles was rapidly approaching this mark.

As far as there was an inability to produce modern high-precision missiles in the necessary quantities, as a result of the sanctions policy of democratic states, the aggressor was forced to bypass the current international sanctions and look for the possibility of purchasing high-tech components for the production of such missiles in countries with authoritarian-dictatorship regimes. As a result of such agreements, Iran began supplying Russia with long-range (more than 1,000 km) strike UAVs ("Shahed-129", "Mohajer-6", "kamikaze drones" — "Shahed-136" and "Shahed-131"), which to some extent became an alternative to high-precision missiles.

On September 11, 2022, the first case of the use of Iranian-made "kamikaze drones" was recorded. One such drone, "Shahed-136" struck an industrial facility in Cherkasy but without significant destruction and consequences. Already on September 13, 2022, the air defence units of the Ground Forces of the Armed Forces of Ukraine shot down the "Shahed-136" for the first time [7, P. 129]. On September 20, "Shahed-136" was shot down by small arms and anti-aircraft artillery weapons near Ochakiv (Mykolaiv Region). There, during an attempt to attack a military facility on September 23, the Mohajer-6 unmanned air defence system (delivered to the Russian Federation from Iran on August 19, 2022 [7, P. 129]) was suppressed by EW means and hit with

MANPADS, which fell into the water with minimal damage and was captured by the Ukrainian military.

The enemy tried to force the Defence Forces of Ukraine to reduce the density of anti-aircraft coverage of important military facilities and elements of the state's critical infrastructure through the massive use of attack UAVs. The aggressor directed efforts to disrupt the air defence system of Ukraine and forced it to spend its arrays (stockpiles) of anti-aircraft guided missiles on air targets of lower priority instead of defeating more powerful in terms of weight of the combat units, better in terms of accuracy of guidance of ballistic and cruise surface, subsurface and air-based missiles.

After the operation was successfully carried out by the Ukrainian special services, as a result of which the Crimean Bridge was damaged on October 8, 2022 [8, P. 20], the Russian military and political leadership switched from October 10, 2022, to the practice of launching massive missile strikes on the critical infrastructure objects (mainly on the unified energy system) all along the territory of Ukraine [8, P. 131].

The enemy's missile attacks were characterized by the desire to exert constant powerful pressure on the Ukrainian air defence system with almost daily strikes by cruise (ballistic, aeroballistic) missiles and by overloading it with numerous "kamikaze drones". As a rule, the strikes were carried out in two or three waves with a time interval of up to 1 hour, with a total force of no less than several dozen missiles. At the same time, waves of cruise missiles were supplemented by waves of barrage ammunition at night before or after the strike. Thus, the first massive strike in the morning of October 10 was followed by an attack by "kamikaze drones" in the afternoon. The next day, the enemy launched another 28 missiles and 14 drones. The drone strikes continued on October 12, during which no less than 17 "Shahed" UVAs were shot down by Ukrainian air defence, five of which were shot down by a Ukrainian MiG-29 [8, P. 128].

The attempted attack by "kamikaze drones" on Kyiv at dawn on October 17, 2022, was generally successfully repelled not only by air defence units but also by units of the National Guard and the National Police of Ukraine, using small arms [8, P. 128]. The failure of the attack on Kyiv forced the enemy to continue to use "kamikaze drones" mainly at night. According to this, as well as the relatively low speed of "kamikaze drones" there was a need to arm the MVG with large-caliber machine guns (along with MANPADS) and equip such groups with lighting and thermal imaging equipment. These groups became the main, relatively "cheap" and effective means of countering the "Shahed" UAVs. At the same time, to fight against "kamikaze drones" units armed with MANPADS, anti-aircraft units, and even fighter jets from tactical aviation brigades were involved [8, P. 128].

Ukraine was forced to build an echelon air defence system to create an effective system of alerting state administration and local self-government bodies, the civilian population, and command posts of troops (forces) about an air threat. The built anti-aircraft system made it possible to solve the task of timely detection and destruction of "traditional" air targets — airplanes and helicopters and also provided countermeasures to the mass use of enemy UAVs, cruise and ballistic missiles to a greater extent. To combat the Russian-made "Lancet" and "Kub", Iranian-made "Shahed-131" and

"Shahed-136", 'kamikaze drones', the units of the Defence Forces of Ukraine used all air defence means suitable for this task. Effective means of combating UAVs of this type were anti-aircraft missiles and short-range anti-aircraft gun systems: "Wasp", "Strela-10", "Gepard", "Tunguska", "Shilka"; MANPADS "Stinger", "Starstreak", "Strela", "Needle"; small-calibre anti-aircraft artillery of the ZU-23-2 type; organized small arms fire.

From the end of November to the beginning of December 2022, Russian air strikes were practiced on days when, due to difficult weather conditions (fog, low cloud cover), it was impossible to use visual control tools to identify targets and MANPADS to destroy them. Blows were delivered mainly to the same objects with a certain periodicity, with the aim of keeping them in a non-working state [9, P. 108—116].

The purpose of such massive strikes was to overcome the air defence system of Ukraine and increase the percentage of effective hits on energy facilities. As a result of the strikes, the unified energy system of Ukraine had to suffer critical damage, which, according to the enemy's design, would not allow further maintenance of the proper level of functioning of all types of civil infrastructure, "decision-making centers", bases and deployment points of military units of the Defence Forces of Ukraine. In fact, the goal of the mass use of missile weapons and attack UAVs from October 10, 2022, was not just a military-economic but primarily a humanitarian disaster for the civilian population of Ukraine in the conditions of the autumn-winter period. An additional threat on a global scale was the disruption of the energy supply system to ensure the regular operation of reactors at Ukrainian nuclear power plants.

The autumn-winter stage of massive use of air attack by the aggressor was also characterized by finding out new tactics for the use of cruise missiles, as well as new means of inflicting fire damage. At the same time, it became more and more obvious that the stocks of high-precision and, in some places, even less accurate missiles were being depleted. In the conditions of a constant reduction in the stocks of the main means of missile strikes — cruise missiles 3M-14, Kh-101, as well as aero ballistic hypersonic missiles Kh-47M2 — the enemy began to use: modernized strategic cruise missiles Kh-101, manufactured in 2021-2023, cruise missiles Kh-55SM missiles manufactured in 1988—1990 (which were used without additional overhead tanks and using a mock-up simulator instead of a nuclear warhead), anti-aircraft guided missiles 48H6DM of the S-300PM2 and S-400 anti-aircraft missile systems (in operational mode against ground targets already tested by numerous strikes of similar ZKR 5V55 in Kharkiv region and Mykolaiv region, but at a greater distance), version of "kamikaze drones" "Shahed-136" (probably produced in the Russian Federation with the involvement of more affordable electronic components and blocks under sanctions pressure), balloons with corner reflectors to oversaturate the Ukrainian air defence system with false targets [12, P. 137].

According to the systematic active mission of the enemy's attacks on the objects of the unified energy system of Ukraine (substations, thermal power plants, hydroelectric power plants) using missile weapons and "kamikaze drones", the system of anti-aircraft missile cover was strengthened entities of the energy infrastructure of Ukraine. This led to an increase in the number of MVGs armed with MANPADS

and large-caliber machine guns. As a result of a large number of air defence systems, it became possible not only to cover important objects but also to manoeuvre them in the areas of the flight of the enemy's air attack immediately during the strike, taking into account the analysis of the air situation at the current moment.

Providing modern air defence equipment by the partner states within the framework of the international military-technical help ("IRIS-T" air defence system and "Gepard" air defence system — from the beginning of October, "NASAMS" air defence system — from the beginning of November 2022) made it possible to increase the proportional share of downed enemy air attack equipment on the average up to 72 %, in contrast to 23 % in March-September 2022. In some cases, there were recorded up to 90 % destruction of not only "kamikaze drones" but also cruise missiles on the approach to certain energy infrastructure objects [8]. For example, during a massive strike on December 5, 2022, the MVG of the 164th Radio Engineering Brigade destroyed seven out of eight cruise missiles passing through their areas of responsibility.

The challenge for the Defence Forces of Ukraine was the use by the Russians of long-range anti-aircraft guided missiles 48H6DM (converted to hit ground targets) from the S-300PM2 and S-400 anti-aircraft missile systems to hit critical infrastructure facilities in Kyiv and the Kyiv region. The enemy's use of these missiles against ground targets was recorded for the first time on December 29, 2022. The most massive use of missiles of this class was marked by the "New Year's" strikes on the city of Kyiv on December 31, 2022 [10, P. 73, 75, 83] and January 14, 2023 [11, P. 121]. Thereby, the adversary confirmed its intentions to deliberately expand the practice of terrorist attacks on ground targets with anti-aircraft-guided missiles using a notoriously low-precision ballistic flight trajectory. The hypersonic speed at the initial stage of the flight and the short approach time to the target (on the order of a few minutes) made it impossible not only to intercept them with the available air defence means but also to give a timely warning about air danger. Thus, on January 14, 2023, air danger was declared in Kyiv after the first hits of 48H6DM missiles on urban buildings [11, P. 121]. At the same time, the use of 48H6DM allowed the enemy to partially compensate for the shortage of Kh-101 and 3M-14 "Kalibr" missiles as part of typical missile strikes against the energy infrastructure of Ukraine.

After realizing that only supersonic and hypersonic missiles can safely bypass the Ukrainian air defence system, since mid-January 2023, the occupiers systematically supplemented the waves of cruise missiles with "Kinzhal" aeroballistic missiles and Kh-22 and Kh-32 supersonic cruise missiles. As in 2022, the deliberate use of Kh-22/Kh-32 missiles against objects in the middle of the city led to terrible consequences and losses among the civilian population. In particular, on January 14, 2023, such a missile hit a multi-story residential building in the city of Dnipro, as a result of which 44 people died and another 80 were injured [11, P. 120—121]. During the missile attack on February 16, 2023, the share of Kh-22/Kh-32 missiles already reached a third of the total volume of missiles used. From that moment, there was an increase in the use of low-precision missiles (Kh-22/Kh-32) and a further reduction in the use of high-precision missiles (Kh-101 and 3M-14) [12, P. 136—137].

At the same time, the Ukrainian air defense system remained ineffective when the enemy used ballistic and supersonic missiles, which was due to the inability to detect them in time and the lack of means capable of intercepting such missiles (missile defence complexes (hereinafter — ABM) of the MIM-104 type) "Patriot" and "SAMP-T").

The massive missile strikes on the territory of Ukraine in October 2022 — March 2023 did not achieve their goal. The adversary failed to cause critical damage to the unified energy system of Ukraine, which could cause a complete shutdown of electricity supply throughout the country or at least in large cities or individual regions of Ukraine for a period of more than 1—2 days. Temporary shutdowns of electricity consumers of the 2nd group (population) and, to a lesser extent, the 1st group (industrial and similar consumers) did not significantly affect the functioning of important civil administrative, industrial, infrastructure, and military facilities. An important role in leveling this threat was played by operational measures of the Ukrainian state and private enterprises to overcome the consequences of damage to the unified energy system; effective assistance of Western partners in providing sufficient volumes of necessary spare parts and power equipment; readiness and ability of Ukrainian society to adapt to emergency conditions caused by energy supply problems.

The dynamics of the aggressor's strike mission show that at the beginning of 2023, it had critically depleted the stock of long-range cruise missiles and spent a significant portion of other types of missile stock. The effectiveness of missile strikes by the enemy decreased primarily due to the increase in the capabilities and efficiency of Ukrainian air defence thanks to the provision of a significant number of modern air defence systems and means by partner states within the framework of the international VTD, a partial update of the armament of anti-aircraft missile forces, the deployment of many MVG to fight both cruise missiles and with shock UAVs.

Realizing the futility of continuing to carry out massive missile and combined strikes against the unified energy system of Ukraine in the conditions of effective countermeasures by Ukrainian air defence, against the background of the depletion of necessary weapons and the approach of spring warming, the enemy suspended the practice of massive missile strikes at the beginning of March 2023.

As for the remaining missile potential of the Russian Federation, it becomes obvious that it is impossible to accurately count and operate with data on the number of missiles remaining in the enemy's possession. It is only possible to provide an approximate estimate of the estimated remains of high-precision missiles and the presence of remains in warehouses and storage bases of other less accurate missiles (including those from the reserves of the USSR), where their use in confrontation with the NATO block was assumed for years before the calculation of the quantity. Most of them are already outdated and quite inaccurate — although their number is huge. There is also a search for the possibility of acquiring ballistic missiles in North Korea and Iran. This may indicate that the Russians have colossal problems with ballistic missiles or, rather, with their quantity [29]. However, the occupiers have enough modern high-precision missiles of the "Iskander", "Kalibr", Kh-555, and Kh-101 types for years of military operations in the "economic mode" (to hit the most critical and important targets),

especially considering the ability of Russian industry to produce up to a hundred missiles of various types per month to circumvent the imposed sanctions, not even considering the rest of the range of less accurate missile weapons. And this means that Ukraine will have to constantly invest in the creation of the country's anti-aircraft and anti-missile defence in the coming years [29].

* * *

1) From February 24, 2022, to February 28, 2023, the Russian Federation launched about 4,069 air, sea, and land-based cruise and ballistic missiles over Ukraine. Units of the Defence Forces of Ukraine intercepted 873 cruise missiles, which is 49.1 % of the total number (1,777 missiles of this type) used by the Russian Federation during airstrikes on the territory of Ukraine. Also, during the specified period, the military formations of the Russian Federation lost 300 aircraft, 288 helicopters, and 2,051 UAVs of operational-tactical level. Against the backdrop of the effective performance of Ukrainian forces and air defence and aviation assets, the aggressor was forced to stop using manned aircraft over the territory controlled by the Defence Forces of Ukraine.

2) In the first hours and days of the wide-scale Russian invasion of Ukraine, the military-political leadership of the Russian Federation chose tactical and transport aviation airfields, positions of radio engineering and anti-aircraft missile brigades, control facilities of the Armed Forces of Ukraine (headquarters and command posts) as the main targets of the air attack, fuel, and ammunition storage places. Considering the tactics of manoeuvrable defence, the dispersion of forces and the means of Ukrainian military units, the aggressor did not manage to inflict significant losses on the Defence Forces of Ukraine and their combat capabilities. From the end of March 2022, the Russian Federation began to launch missile and bomb attacks against critical infrastructure facilities (defence and civilian industries, fuel storage facilities, energy facilities), logistics routes (railway infrastructure facilities, automobile and railway overpasses) and areas of concentration and deployment of troops (training centers, points of permanent deployment of military units, training grounds, territorial centers of recruitment and social support). A characteristic feature of the period from October 2022 to February 2023 was the task of systematic massive (mostly combined) strikes by long-range missiles and UAVs with the aim of destroying the critical energy system of Ukraine.

3) The result of the Defence Forces of Ukraine receiving air defence systems and means from Ukraine's partner states within the framework of the international MTA was the saturation of Ukrainian units with the corresponding highly effective models, a multiple-fold increase in their combat potential, and effectiveness. It was possible to include the air defence systems and samples provided to Ukraine in the general air defence system and block critical directions and airspace zones. Air defence systems and equipment provided within the framework of the international military-technical support made it possible to increase the damage to the air defence equipment of the Air and Space Forces of the Russian Federation to 80—90 %. Saturation of the front edge of the defence MANPADS and short-range air defence systems made it possible to push the enemy's aviation behind the line of his battle formations. From

February 24, 2022, to February 28, 2023, Ukraine received 7,970 units of air defence systems and means from partner states, which fundamentally affected the quality and effectiveness of Ukrainian air defence and the number of destroyed enemy air targets.

4) The air defence system available in Ukraine in February 2022 — February 2023 remained insufficiently effective in countering ballistic, hypersonic, and supersonic missiles, which was due to the inability to detect such targets in a timely manner and the lack of means capable of intercepting such missiles. Of the 2,292 ballistic missiles used by the Russian Federation, only a few were intercepted. Accordingly, Ukrainian air defence units urgently needed to be strengthened with modern complexes and means of countering air targets of the appropriate class.

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Володимир КОНОПКА
кандидат історичних наук, старший офіцер Центру досліджень
воєнної історії Збройних сил України (Київ, Україна)
grafalf@gmail.com
https://orcid.org/0000-0003-0872-1833
Сергій ТАРАНЕЦЬ
доктор філософії, начальник відділу Центру досліджень
воєнної історії Збройних сил України (Київ, Україна)
korsak111@gmail.com
https://orcid.org/0000-0002-0979-7496

ПРОТИДІЯ СИЛ ОБОРОНИ УКРАЇНИ ЗАСОБАМ ПОВІТРЯНОГО НАПАДУ РОСІЙСЬКОЇ ФЕДЕРАЦІЇ (24 лютого 2022 — 28 лютого 2023 рр.)

Мета — на основі аналізу та порівняння доступних даних простежити характер повітряного нападу Російської Федерації першого року повномасштабної війни, вказати способи протидії Сил оборони України та засоби ППО, які вони використовували. **Методологія дослідження** ґрунтується на принципах історизму та неупередженості, використано порівняльно-історичний і статистичний методи. **Наукова новизна.** Наведено дані стосовно кількісних характеристик наявних сил і засобів повітряного нападу в агресора — збройних сил Російської Федерації. В науковий обіг уводиться інформація щодо відбиття повітряного нападу РФ із 24 лютого 2022 до 28 лютого 2023 рр., проведено класифікацію комплексів та засобів протиповітряної оборони, отриманих Україною в рамках міжнародної військової матеріально-технічної допомоги за принципом етапності отримання й дальності дії. У **висновках** відзначено результати російських повітряних ударів та протистояння їм українських підрозділів ППО, визначено наміри військово-політичного керівництва РФ і хронологію типів повітряних ударів. Підраховано, що впродовж 24 лютого 2022 — 28 лютого 2023 рр. Україна отримала від держав-партнерів 7970 одиниць комплексів та засобів ППО, і це кардинально вплинуло на перебіг російсько-української війни. Окреслено напрями посилення українських сил протиповітряної оборони.

***Ключові слова**: війна Росії проти України, широкомасштабне вторгнення, Сили оборони України, ППО, військова авіація, крилаті ракети, балістичні ракети, БПЛА, міжнародна військова матеріально-технічна допомога.*