SRCAA

"ZOND"

MANUAL
OBSERVATION AND IDENTIFICATION OF AEROSPACE OBJECTS AND PHENOMENA

2025

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AEROSPACE SOCIETY OF UKRAINE

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OBSERVATION AND IDENTIFICATION OF AEROSPACE OBJECTS AND PHENOMENA

MANUAL

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The target users of this Manual "Observation and Identification of Aerospace Objects and Phenomena" (hereinafter – Manual) are observers, investigators and other related persons, involved in visual and optoelectronic surveillance, detection and identification of objects and phenomena in aerospace.

The purpose of the Manual is to raise awareness about modern methods and means of surveillance, detection and identification of objects and phenomena that can be observed in aerospace; to provide materials for self-training, to show visual examples of registration of unidentified aerospace objects and phenomena.

The Manual do not contain detailed instructions for the use of specific hardware methods for observing, detecting and identifying aerospace objects and phenomena. It provides general guidance on the capabilities and limits of each described method applicability.

These Manual can be used as an educational and methodological material in the training of unmanned aerial vehicle operators, air defense specialists, other military and civilian specialists involved in the observation, detection and identification of aerospace objects and phenomena.

The Manual do not claim to be a complete description of all methods and techniques for observing, detecting and identifying aerospace objects and phenomena, and may be amended and supplemented as new experience is gained. The Manual provide methods that can be used by most persons, involved in aerospace monitoring to study aerospace objects and phenomena with minimal resources.

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CONTENTS

1. MAIN METHODS AND MEANS FOR OBSERVATION, DETECTION AND IDENTIFICATION OF AEROSPACE OBJECTS AND PHENOMENA

This section of the **Manual** provides a general description and features of the main methods and means of observation, detection and identification of aerospace objects and phenomena.

1.1. Methods for observation, detection and identification of aerospace objects and phenomena

AOP monitoring consists of the following main stages (Fig. 1.1).

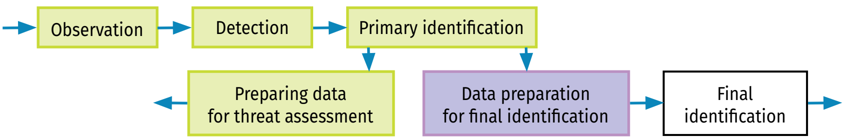


Figure 1.1 – Main stages of aerospace objects and phenomena monitoring

The scope of this Manual is to monitor, detect and initially identify AOPs, as well as to prepare data for assessing threats from them and, if necessary, data for the final identification of unidentified AOPs.

Observation of the ASD is carried out visually or with the help of technical means.

Detection of AOP in ASD is the process of establishing presence of AOP as a result of observation of ASD using various methods. At the present stage, the following main **methods** are known for **detecting** AOP in ASD:

- visual;
- thermal;
- acoustic;
- radio frequency;
- radar.

Visual methods for detecting AOP include both the use of an eye gauge and special technical means that allow detecting the characteristics of AOP for further identification.

The advantages of visual methods of detecting AOP are their availability, high mobility and speed of usage. The disadvantage of visual methods of detecting AOP are the inability to detect AOP in low light conditions (for example, at night) without special equipment, such as night vision devices, thermal imaging cameras, etc. In addition, visual detection is sensitive to the possibility of so called overidentification. Many moving objects, such as birds, insects, balloons, certain types of clouds, satellites, missile launch effects, etc. can be mistakenly identified as unmanned aerial vehicles (UAVs) or missiles, etc. Visual detection methods without the use of special technical means are not very informative in modern conditions. Also, identification of “friend or foe” is complicated because many countries use the same or mostly similar models of aircrafts and UAVs. Visual distinguishing marks on an object are usually difficult to see from a long distance, and other countries may take misleading measures, such as disguising UAVs as birds, using symbols of your country, or protective coloring that distorts the visible outline and/or color of the object.

Thermal detection methods detect the heat emitted by engines or other components of AOP. Specialized thermal imaging devices can record the infrared radiation of any object with a temperature and convert it into a visible image. This process is called thermography. It makes possible to detect AOP that are invisible to the naked eye by their thermal signatures.

However, adverse conditions such as fog, smoke or heavy rain can seriously affect the performance of thermal imagers. In addition, modern artificially intelligent aerial vehicles (AV) and UAVs are often made of low-emitting materials, such as insulated, polished or reflective surfaces; thermal signatures can be intentionally distorted by camouflage. In addition, not all AOPs have distinct thermograms.

Acoustic methods use special sensors to detect the unique sound signature of objects in the air and locate them. These sensors perform advanced analysis of the sound spectrum of the environment, detecting activity that corresponds to the unique acoustic signatures of different types of objects. When these sensors detect the presence of an object, they automatically extract its sound and compare it to the reference points in an integrated database. When an equivalence is found, the system records the identification information and sends an automatic notification. The main disadvantages of acoustic methods are low accuracy and the inability to detect AOP in an airless (space) environment. In addition, some AOP may be supersonic, silent or low-noise in nature, mixed or jammed with other natural sounds.

Radio frequency methods. The majority of artificial aerospace objects are controlled and/or communicate using radio frequency radiation. Using special receiving equipment for radio frequency spectrum analysis, even weak radio signals can be detected at a considerable distance and potentially detect the presence of artificial objects in the ASD.

The main advantages of the radio frequency methods are the detection range and the ability to identify a specific type of objects in limited visibility, regardless of weather conditions, and the passive operation of the equipment. Radio signals also propagate at the speed of light, which allows detection systems to respond extremely quickly to changes in the radiation of objects.

The disadvantages of radio frequency methods detection of AOP are the need for special equipment, the possibility of signal spoofing or avoiding detection through radio silence, non-standard frequencies, etc. Some autonomous, swarming, or wired-controlled

UAVs cannot be detected by radio frequency methods. Ultimately, radio frequency spectrum analysis can only detect man-made objects in the ASD, being of little use for identifying all other, including natural, AOP.

Radar methods. Radar detection is carried out using special radar systems. The transmitter of a radar system emits radar signals that interact with objects as a result of reflection or scattering. These altered waves are then received by the radar receiver, where sophisticated algorithms convert them into a visual format, providing valuable information about the size, structure and composition of the object. Objects located closer or further away from the transmitter create the Doppler effect, i.e. distortion of the radio waves. Pulsed Doppler radar systems used to detect UAVs periodically emit radio waves and measure the returned radar signal to estimate the distance, speed and characteristics of the detected object.

However, UAVs, for example, are mostly made of plastic that is invisible to radar, and only their metal cameras, batteries and engines provide reflectivity for signals. The disadvantage of radar detection methods is the limited radar range: UAVs are smaller than manned aircraft and tend to fly close to the ground surface, making them difficult for most radars to detect [8].

Special coatings and shapes of aircraft, as well as deception measures and the use of dipole and corner reflectors, can distort the reflected radio signal, making it difficult to detect and identify AOP. Certain natural phenomena, such as groups of birds, have a significant **effective scattering area** (a characteristic of a target's reflectivity, determined by the ratio of the power of electromagnetic energy reflected by the target in the direction of the receiver to the surface energy density of a downgoing plane wave), which can lead to misidentification.

These **Manual includes only visual and thermal methods for detecting AOP** in ASD, as they are common and available for use. The most effective method is a combination of different methods for detecting and identifying AOP.

Initial identification is carried out directly by the persons involved in monitoring and detection of AOP or automated using specialized technical systems. Initial identification is the basis for assessing threats and making a quick decision on how to neutralize them if detected.

The **data for threat assessment** is **prepared** directly by the persons involved in monitoring and detecting AOP or by other specialists, based on the initial identification, in order to prepare and promptly transmit information to the relevant officials for making decisions on neutralizing possible threats. Data for threat assessment includes the following key AOP parameters: direction of movement, trajectory, speed, general description, etc. It should be sufficient to make a decision on how to neutralize possible threats, which is the absolute governmental priority.

The **data for a final identification** is **prepared** directly by the persons involved in the monitoring and detection of AOPs or by other specialists, based on the initial identification. The final identification is aimed at conducting an analysis, which is carried out if, as a result of the initial analysis, the AOP remained unidentified. The data required for final identification are described below. However, non-identification as a result of the initial identification is not an obstacle to preparing threat assessment data and making a decision on the possible neutralization of the observed AOP.

The limits of applicability of AOP detection methods depend on the features of the technical equipment for monitoring the ASD and the means necessary for its placement [9].

1.2. Means and devices for monitoring aerospace objects and phenomena

AOP **monitoring tools and devices** are divided into passive and active. The active ones are characterized by the presence of radiation or other impact in the direction of the monitored object, while the passive ones have no radiation in the direction of the object.

Visual monitoring is carried out with the naked eye or with the help of special optoelectronic means (binoculars, monoculars, telescopes, scopes) and devices (thermal imagers, night vision devices, sighting devices). As a rule, visual monitoring equipment and devices are passive; exceptions are special searchlights, targeting lasers, and infrared illumination of night vision devices. Visual monitoring means and devices for AOP can be either individual or group, worn or integrated into equipment.

Monitoring equipment and devices are individual (micro-level), local (meso-level) and global (macro-level) electronic and mechanical systems that measure and record the state of the environment.

Global monitoring systems for ASD in Ukraine include satellites, meteorological stations and radar stations. Local systems currently include departmental and private devices, aircraft, etc. Individual electronic and mechanical systems that are rapidly developing include mobile devices, smartphones, surveillance cameras, mini-radars, portable stations for determining meteorological conditions, environmental parameters, etc. [6, 8].

Different methods of monitoring and detecting ADA determine the use of different technical means and devices for monitoring of AOP:

– cameras, night vision devices, telescopes, binoculars, etc.;
– thermal imagers;
– satellites and spacecraft;
– manned and unmanned aerial vehicles, missiles;
– probes, aerostats, stratospheres;
– special stationary and mobile monitoring systems.

Due to the full-scale aggression of the russian federation, Ukraine currently has tens of thousands of different ASD monitoring devices. As the number of ASD monitoring systems and the level of professionalism of the personnel involved grows, the number and quality of AOP reports increases.

Identification of AOP is the process of establishing the identity of the observed parameters and features of AOP to the corresponding parameters and features of known AOP of anthropogenic and natural origin.

AOP parameters are data that describe the AOP and can be expressed numerically (e.g., speed, size, brightness, etc.).

AOP features are data that qualitatively describe AOP and cannot be expressed numerically (e.g. color, shape, etc.).

The identification of AOP can be carried out **visually, on the basis of prepared hardware data**, **and automated (software)**. The final decision on the results of the AOP identification is made by a designated responsible person.

Cameras, **night vision devices**, **telescopes**, **binoculars**, **etc.** are visual monitoring devices and instruments for ASD (Fig. 1.2). They can be portable, stationary or mounted on moving vehicles and equipment.

Visual identification of AOPs is carried out by their details, outline, behavior, distinctive marks, aeronautical lights or light effects.

Figure 1.2 – Examples: A stationary video camera; an individual night vision device; a portable handheld visual reconnaissance system

Thermal imagers are specialized devices that detect thermal (infrared) radiation from AOPs and generate images based on temperature differences (thermal signatures). There are portable thermal imagers, stationary thermal imaging systems and those integrated into vehicles, aircraft/ UAVs that allow detecting AOPs even in the dark or in bad weather conditions (Figure 1.3). The thermography of AOPs includes their observability in the infrared spectrum; temperature distribution over the body of the AOP; type and rate of change of the AOP temperature over time, which may indicate certain processes occurring with the AOP. The disadvantages of thermal imagers are a long switch-on time, blurring of objects at high background temperatures, inability to detect AOP at low temperature differences between the background and the object, the need for optical focusing on the object, and some dependence on weather conditions.

Satellites and spacecraft monitor AOP from an extremely long distance. Space imagery is capable of providing highly accurate visual detection of AOP, thermography, electronic reconnaissance, etc. Almost all types of equipment for collecting information on AOP can be installed on satellites and spacecraft.

The visibility of near-Earth space makes it possible to carry out global monitoring by space assets over all areas of the Earth's surface, including the AOP, in near-real time.

The disadvantages of satellites and spacecraft as carriers of monitoring tools are their considerable distance from the Earth's surface, which requires the use of powerful optical devices; possible incomplete coverage of the Earth's surface due to the insufficient number and mobility of satellites and spacecraft in orbit; observation is usually focused only on narrow areas. The high cost of satellites and spacecraft and the limited possibilities for their launch and modernization cause inertia in the implementation of the latest methods of the AOP observation from space.

Manned and unmanned aerial vehicles, **missiles**, due to their relatively low cost, are the most affordable carriers of monitoring systems in the ASD (Fig. 1.3). The active use of UAVs in the ASD, especially in the area close to the warzone, makes it possible to monitor the AOP in close to real time and to make prompt decisions based on threat analysis.

Manned vehicles can be more informative and facilitate faster decision-making when the crew detects an AOP, but they put the crew at risk.

The low visibility of UAVs, their maneuverability, and the ability of some types to hover for a long period of time over one point on the

Earth's surface allows obtain a significant amount of information about AOP. The high speed of UAVs allows became closer to AOP for better visibility.

Figure 1.3 – Individual thermal imager; reconnaissance satellite; UAV

Missiles can be quickly deployed for additional monitoring AOP with their prior detection by other means. The disadvantages of using missiles to deploy AOP monitoring systems are their high speed and low maneuverability.

Observation ballons, **aerostats**, **stratospheric balloons** are low-mobility means for deploying ASD monitoring systems. Aerostats can be stationary and mobile, with engines or self-flowing in the wind (Fig. 1.4). The advantages of stationary monitoring aerostats are their cost-effective operation at a high altitude and a big area of observation. The general disadvantages of aerostats and balloons are their vulnerability to weather conditions, wind loads, and, for moving types – low speed and limited range. It is difficult to camouflage such equipment on the ground.

Special stationary and mobile monitoring systems are among the most promising for monitoring and detecting AOP, as they are relatively inexpensive, allow deployment of a monitoring network, are easy to disguise, and can be quickly upgraded. Stationary systems are placed on the ground, towers and masts, building elements, etc. Mobile monitoring systems are placed on vehicles, equipment, special

Figure 1.4 – Observation balloon; reconnaissance stratospheric balloon

unmanned mobile platforms, etc. The peculiarity of monitoring systems is multispectral, availability of hardware, data recording and transmission devices.

Figure 1.5 – Mobile monitoring systems for ASD

The disadvantages of stationary and mobile monitoring systems are the low height from which observations are made and, accordingly, the low visibility range.

2. TYPES OF PARAMETERS AND FEATURES USED FOR IDENTIFICATION OF AEROSPACE OBJECTS AND PHENOMENA

This section of the **Manual** sets out: requirements for a set of parameters and features of AOP necessary for their initial identification; general parameters and features of AOP, parameters and features of AOP location in space and their movement.

The primary identification is based on key visually observable **features** and measurable **parameters** of the AOP, including the visible outline, shape and details of the AOP, possible acoustic and light effects, motion characteristics, etc.

Requirements for a set of parameters and features for visual observations of AOP:

- they should comprehensively characterize the AOP in order to make an identification with a high level of confidence;
- they should be measured using available tools and instruments;
- they should have known limits of variability for different observation conditions.

Below there are the main parameters and features that are used to describe the observed AOP, its recognition, methods and units of measurement. Data on some parameters and features can be obtained both with the help of technical means and devices (see above) and as a result of direct visual observation [10].

2.1. General parameters and features of an aerospace object or phenomenon

Maximum possible observation time. It characterizes the period during which an AOP can be observed: from the first manifestations to its complete disappearance. This parameter may or may not coincide with the actual observation time of the AOP (a characteristic of a specific observation, not the AOP as a whole), which is measured from the moment of detection or appearance of the AOP to the moment of the end of observation or disappearance of the AOP. It is measured in seconds.

Outline. The outline is a qualitative feature that characterizes the contour of the observed AOP; it can be clearly defined, have a varying degree of blurring or merging with the environment, background, and be variable. If the outline changes during observation, each stage of such changes is described.

Shape. The shape of the AOP is initially indicated in accordance with analogies with simple geometric shapes and known bodies. In the detailed description, the specifics of the shape and its individual elements are indicated, etc. If the shape changed during the observation, the sequence of its changes (polymorphism) is indicated. The shape is a qualitative feature of the description of the AOP.

Color. The color of the AOP is a qualitative feature of its Description For clarity, illustrative material in the form of eyewitness drawings, preferably photos, videos, etc. should be attached.

Linear dimensions. At the initial stage, the parameter of the diametric size of the circle described around the visible outline of the AOP is determined. Subsequently, if possible, the sizes of individual parts, elements of the AOP, are determined. If a group of objects/ phenomena with synchronous movement is observed, it is advisable to calculate both the sizes of individual NSAs and the group as a whole. If during the observation there were changes in the size of individual parts, elements of the AOP, then their dimensions are indicated sequentially. Linear dimensions are measured in meters.

Angular dimensions. The parameter of the angular dimension is determined with the help of technical means and devices, as well as meters a result of direct visual observation, by analogy with known objects and relative values. Angular dimensions are measured in angular degrees.

Light effects. The light effects are one of the defining parameters and features of the description of AOP. The peculiarities of localization and possible changes in light effects over time are described by qualitative indicators (parameters), but the size of the rays, brightness, etc., can be expressed quantitatively only (as a features). In particular, the maximum and minimum observed brightness of AOP can be represented in candela/square meter.

Thermal signatures. The thermal signatures can be determined accurately only with the help of technical devices. Indirectly, the temperature of the AOP may be indicated by light effects and the effects of interaction with the environment. As a parameter of AOP, its temperature in Celsius degrees is indicated, as well as qualitative features of its distribution. If the temperature distribution is uneven, it is indicated for all individual visible parts and zones of the AOP.

2.2. Parameters and features of the location of an aerospace object or phenomenon in space

Number. Single AOP can be observed, as well as groups of them, series, for example, aircraft formation, swarms of drones, etc. Sometimes it can be difficult to identify whether an AOP is a single object or a group of disparate objects. In this case, an in-depth analysis of this quantity parameter is used or various options are considered.

Configuration. During the observation of multiple AOP, their relative position is important. The configuration is a qualitative feature that is supported by illustrative material (drawings, photos, videos, screenshots, etc.).

Altitude. The altitude of the AOP is important information and one of the key parameters for identification. The altitude is measured in meters from the ground surface level or from the sea level to the AOP. During visual observations, when there is a variation in altitude values, its maximum and minimum possible values are analyzed separately.

Angle to the horizon. This parameter is measured in degrees, from the horizontal parallel to the ground to the AOP or their group. With a variable angle above the horizon, the altitude at the beginning of the observation and at the end of the observation is indicated.

The direction of observation. This parameter is calculated as an azimuth (clockwise angle between the north direction and the object/ phenomenon). The direction of observation is measured in angular degrees.

2.3. Parameters and features of movement of an aerospace object or phenomenon

Maximum hover time. A parameter that characterizes the period from the visual static stop of the AOP to the continuation of its movement. The hover time may be visual evidence from the observer and may not be a capability of the AUV itself, for example, an aircraft moving in a plane towards or away from the observer may appear to be hovering in one place. Hover time is measured in seconds.

Trajectory. This feature can be straight, close to straight, or curved. When recording an observation, a complex trajectory is described step by step, with its breakdown into separate characteristic sections, with reference to time and reliance on spatial external landmarks. The trajectory is mainly described qualitatively, but its changes can be supplemented by a geometric description of measurable individual sections, etc.

Linear velocity. It is one of the key parameters for identifying AOP. It is measured in meters/second.

Angular velocity. A measured in degrees/second. It can be visually assessed by how many of its own angular dimensions the AOP passes per unit of time.

Acceleration. If the velocity of the AOP did not change during the observation, then there are no accelerations, the movement is uniform. If there is a change in the velocity of the AOP over time on a certain part of the trajectory, this indicates acceleration or deceleration, i.e. accelerated or decelerated movement. Positive or negative acceleration can also be assessed as steady or increasing. This parameter measured in meters/second squared, with a "+" or "-" sign.

Direction of movement. This parameter is determined by the cardinal points, indicating all stages of possible change during the movement of the AOP. It is measured as an azimuth in degrees. It should be noted that the direction of movement of an AOP is measured in the coordinates of the AOP itself.

Turning radius. If a moving AOP changed direction (made a turn) on certain parts of the trajectory, the key parameters are the values of the radii of such changes. The minimum value of the turning radius is of the greatest scientific value. It is measured in meters.

Angular turning speed. This parameter characterizes the ability of an AOP in motion to change its trajectory within a short time. High turning speeds are of scientific value, so, in addition to a detailed description, the maximum value is indicated if the turning speed varies during the observation. It is measured in degrees/second.

If the AOP parameters change during the observation, its description is divided into stages (phases), each of which describes the AOP states in detail.

When calculating the variability of parameters, their defined interval maximum and minimum values are indicated.

3. CATEGORIES OF OBSERVED AEROSPACE OBJECTS AND PHENOMENA, THEIR PARAMETERS AND FEATURES

This section of the **Manual** describes the following: parameters and features of natural and anthropogenic AOP, parameters and features of unidentified AOP, description of some observed UAP, classification of anomaly factors, examples of UAP observation in the ASD.

3.1. Aerospace objects and phenomena of natural a nd anthropogenic origin

Objects and phenomena in the ASD are classified by their origin – natural and anthropogenic. The description of parameters and features for natural AOP is given in **Annex 1**, and for anthropogenic AOP – in **Annex 2**.

Annex 1 and Annex 2 are focused primarily on natural and anthropogenic AOPs that may look unusual and may be misidentified or not identified. It is taken into account that currently in Ukraine a significant number of objects and phenomena in the ASD may be observed as a result of the effects of military operations.

Some natural-looking AOPs may have anthropogenic causes, such as dust clouds, artificially created clouds, etc. It is also possible that effects of anthropogenic AOPs may be combined with natural AOPs, which distorts their parameters and features and complicates their detection and identification. To this goal, the enemy may intentionally distort the parameters and features of artificial objects.

Separate consideration should be given to cases where natural or anthropogenic AOPs look unusual due to peculiarities or unidentified defects of the observation equipment, i.e. optical effects, glare, aberrations, defects in the frame, matrix illumination (in photo, video cameras, thermal imagers), hardware processing errors, software errors in detecting and identifying AOPs, etc. These **Manual** do not analyze defects and errors of the observation equipment. Also, in this **Manual**, the issues of falsifications and counterfeits are not considered, since the target user of this **Manual** is a disinterested observer seeking to identify the AOP.

3.2. Unidentified aerospace objects and phenomena

If, during the initial identification, an object or phenomenon in the ASD partially or completely does not correspond to the parameters and features of an AOP of anthropogenic and natural origin, it is classified as an unidentified aerial (aerospace) object or phenomenon [7, 8]. To register its observation, a specialized questionnaire from **Annex 3** of these **Manual** should be filled in, an example of which is given in Annex 4.

The manifestations of AOP, the parameters and features of which are highly unlikely to belong to the array of parameters and features of hypothesis phenomena of known origin, are called **Anomaly Factors** (hereinafter – **AF**) [10]. Subsequently, the results of the final identification analysis may show that initially unidentified aerospace objects or phenomena with unusual parameters and features may be enemy aircraft/UAVs, the latest developments, effects of weapons use, the effect of weapons on new physical principles, etc. Unusual objects and phenomena observed in the ASD can be caused by the effects of human technical activity, as well as by processes and objects with abnormal characteristics [15]. If, as a result of the final identification, AFs remain, then such an aerospace object or phenomenon is recognized as an anomalous one – **UAP**. There are many unexplored, usually transient and sporadic phenomena in nature with unusual characteristics, both in terms of phenomenology, physical manifestations, and impact on people and equipment.

Examples of some of the AF of UAP are shown in Table 3.1.

Table 3.1 – Examples of UAP anomaly factors (for reference)

A property of an object or phenomenon	The main AF
Appearance	Sudden appearance Gradual appearance in clear skies
Body	Shape not characteristic of known objects or phenomena Blurred shape
Details	Lack of details inherent in known objects or phenomena Presence of unusual details
Movement	Sudden acceleration or stopping High speed Turning at high speed at sharp angles Abnormal trajectory Long hovers in one place High-speed rotation Inappropriate driving location A non-trivial trajectory
Transformation	Splitting into parts Sudden change of shape, metamorphosis Separation or joining of objects
Effects	Color change, unusual colors Ultra-brightness, flashes, pulsations High or low temperature Rays with finite length, fragmented rays Different types of radiation Non-trivial, remote impacts
Interactions	Landing or take-off in unsuitable locations Environmental, technical and biological impacts Residual effects, environment changing
Disappearance	Sudden disappearance Visual invisibility Gradual disappearance in the clear sky

Some of the possible manifestations of the observed UAPs [14]:

1. UAPs appear as an unexpected and unusual source of light or as objects with lights on them or with lights nearby.
2. UAPs can appear both singly and in groups.
3. The size of UAPs can vary from a few tens of centimeters in diameter to a kilometer or more.
4. UAPs can appear at any altitude, in any weather, at any time, during any phase of their movement, in controlled/restricted airspace, such as airfields.
5. UAPs can be highly maneuverable and make seemingly instantaneous movements with extreme accelerations, sharp-angle turns, sudden stops, and can hover in place for long periods of time. Some UAPs demonstrate movement in a way that contradicts the known principles of physics, fluid and gas dynamics. The movements of an UAP can be strange and completely unexpected and impressive to observers.
6. UAPs can be detected on radar while being visually invisible or detected visually without radar detection [11].

It should be noted separately that ordinary objects/phenomena in an unusual environment, conditions, or vice versa – unusual objects in an ordinary environment, conditions – are also anomalous. It is a fact that unidentified AOPs are manifested in ASD in conjunction with natural phenomena and human-made means. Thus, unidentified AOPs and UAPs pose a danger to the **national security**, which can be briefly described by the following points [12]:

- UAPs can be used by the enemy or other unknown sides;
- Unidentified objects/phenomena pose a threat of accidental or intentional collision with aircrafts, helicopters, UAVs and other flying means;
- UAPs pose a risk of air defense overloading, of fratricidal losses, and misuse of munitions for militaries;
- UAPs can cause unknown effects on personnel, biological systems, weapons and technical systems;
- UAPs divert the attention of observers from main tasks;

- UAPs cause forced stops and delays of aircraft/UAV flights;
- UAPs are unpredictable and have an unknown nature;
- There is a lack of appropriate guidelines and instructions for the personnel on how to act when detecting UAP in ASD.

The following are typical examples of observations of unidentified AOPs with a significant number of UAPs filmed by the US military in the ASD [13]. In 2004, off the coast of San Diego, a thermal imaging camera of an US Navy F/A-18 Super Hornet fighter jet filmed a video of an UAP during the Nimitz incident, which was officially verified and declassified by the US government and approved for public release [6]. In 2024, the only photo of an unidentified object shot down by the US Air Force over the Yukon (Canada) in 2023 was officially released. The object posed a threat to national security, so it was decided to shoot it down by military fighters (Fig. 3.1).

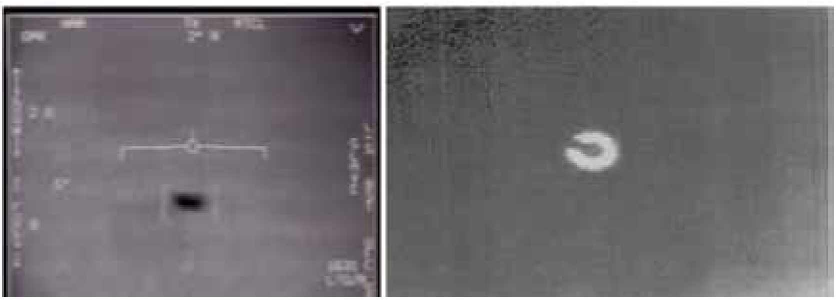


Figure 3.1 – Object filmed by the US Navy in 2004; object shot down by the Air United States Force over the Yukon (Canada) in 2023

On 07 December 2022, in the Middle East (the exact location was not disclosed for security reasons), a video of a UAP in the form of a fast-moving sphere with a metallic shine was captured by a US MQ-9 reconnaissance UAV. The video was officially released by the All-domain Anomaly Resolution Office (AARO), a division of the US Department of Defense that investigates UAPs in all domains – air, sea, space, and land [6]. During an open hearing on UAPs at the US House of Representatives Subcommittee on Counterterrorism and Counterintelligence on 17 May 2022, the Deputy Director of Naval Intelligence released a video of a US Navy pilot's encounter with a metallic shiny sphere (UAP), the location was not disclosed for security reasons (Fig. 3.2) [6]. The US Department of Defense also released an official video filmed off the US coast in 2015 from a US Navy F/A-18 fighter jet with an infrared camera mounted on its cannon. The elongated object had a high speed and rotated while moving [6]. In July 2019, a video shot by the US Navy from the USS Omaha captured an UAP flying in the air over the Navy fleet before plunging into the ocean without a trace. The video was verified and released by the Pentagon (Figure 3.3). According to oceanographer and retired US Navy Rear Admiral Tim Gallaudet, the video is proof of capabilities that threaten US maritime security, already weakened by relative ignorance of the global ocean [6].

Figure 3.2 – Video footage of an UAP in 2022 in the Middle East, released by the US Department of Defense; video footage of an UAP by a US Navy pilot

Figure 3.3 – A shot of a UAP captured on video by the US Navy in 2015; a diving object (UAP) captured on video from a US Navy battleship in 2019

A wedge-shaped formation of a group of 5 spherical unidentified flying objects was filmed by a Mavic 3T drone with thermal imager in Ukraine in the warzone in 2024. The recorded trajectory was straight, with no sounds. The diameter of each object is about 1 m, the speed is about 30 m/s. The results of the analysis (final identification) showed that the objects are UAPs.

Another single hovering flat or cigar-shaped unidentified object was captured on the thermal imaging camera of a Mavic 3T UAV in the warzone in Ukraine in 2024. No sounds were recorded. The diameter of the object was about 30 m. The final identification determined that the object was an UAP (Fig. 3.4).

An in-line formation of a group of 4 spherical unidentified flying objects was filmed by the military using also a thermal imaging camera of Mavic 3T UAV in the warzone in Ukraine, in 2024. The diameter of each object is about 2 m and its speed is about 100 m/s. The results of the analysis (final identification) showed that the objects are UAP. A single ultra-fast cigar-shaped vertical unidentified object was captured on a thermal imaging camera from a Bayraktar UAV in the central Ukraine in 2023 (Fig. 3.5).

Figure 3.4 – Wedge-shaped formation of a group of 5 globular UAPs; hovering flat or cigar-shaped UAP. Military UAV thermal imaging video in the warzone, Ukraine

Figure 3.5 – An in-line formation of a group of 4 spherical UAPs filmed by the military UAV in the Ukrainian warzone; a single ultra-fast near-vertical cigar-shaped UAP filmed using a Bayraktar UAV in the interior of Ukraine in 2023

The recorded trajectory of the object is straight; there are no sounds detected. The calculated size of the object is less than 1 m, and its speed is about 250 m/s. As a result of the final identification, it was determined that the object was an UAP.

Annex 1

PARAMETERS AND FEATURES FOR IDENTIFICATION AEROSPACE OBJECTS AND NATURAL PHENOMENA

Table A.1.1 – Stars, planets

Parameter/ feature	Description	Note
Observation conditions	Cloudless skies, usually in the evening and at night, early morning. Slowly appear/disappear in clear skies	In changeable weather, you can observe the appearance and disappearance of cloud gaps
Appearance, main visual features	The shape is usually spherical, and the outline may be delineated or blurred, depending on the conditions of observation. Color is white to red, but can be visually variable. Apparent lack of movement or slow movement (about 15 degrees per hour) in a straight/arcuate trajectory from east to west. Shaking may occur, movement due to autokinetic visual effects, atmospheric properties, vibrations of optical devices/equipment. At night, bright objects appear closer than they actually are. The planets have their own motion, while the motion of the stars is synchronous, linked to the Earth's rotation. Zodiacal light, is a glow in the ecliptic region that is formed as a result of the scattering of sunlight by a cloud of dust	The position in the sky depends on the date and can be determined by the astronomical calendar. For example, for the planet Venus, it is not high above the horizon, in the morning – in the east, in the evening – in the west. Not visible on radar. No sounds are detected

Parameter/ feature	Description	Note
	particles surrounding the Sun. It is visible as a bright band stretching along the ecliptic. Not visible with a thermal imager	
Residual effects, traces	Absent	

Figure A.1.1 – Jupiter with its satellites in the night sky; a planet parade (Moon, Venus and Jupiter); constellations that can be seen above the horizon

Figure A.1.2 – Zodiacal light; the Milky Way

Table A.1.2 – Sun, parhelium, corona, green ray, eclipse, effects in the clouds, Venus' belt

Parameter/ feature	Description	Note
Observation conditions	From early morning to late afternoon, partly cloudy	
Appearance, main visual features	In the sky, the Sun has a warm yellow hue; during sunrise and sunset, the color can change from red to orange due to the thicker layer of atmosphere through which light passes. The outline in the atmosphere can vary. The observation time ranges from seconds (in clouds) to hours. The Sun can look unusual through the clouds, during an eclipse, at sunset, at sunrise; it can be oval, in the form of a cross, etc. Parhelium (a false Sun or several) occurs as a result of refraction of light from the Sun in anisotropically oriented ice crystals (with unequal properties), suspended in atmosphere. The green ray can be seen just after or before sunset: a green spot, ray or dot appears on the edge of the solar disc for just a few seconds due to atmospheric refraction, and flat discs can be seen. The Venus Belt is an atmospheric optical phenomenon named after the belt of Aphrodite from ancient mythology. It appears before sunrise or after sunset and runs parallel to the horizon at an altitude of 10–20° in a place opposite to the Sun.	More chances to see parhelium in the area, where the horizon is flat. Not visible on radar. No sounds

Parameter/ feature	Description	Note
	Corona are an optical phenomenon in the form of iridescent, light misty rings in the sky around the disc of the Sun or Moon, and less often around bright stars and terrestrial light sources. They appear when translucent clouds or fog pass in front of the source, and differ from halos in the smaller radius of the rings. Visible with a thermal imager.When viewed with the naked eye, phosphenes may be observed for some time. In optoelectronic systems, glare, residual matrix illumination may be observed	

Figure A.1.3 – The Sun: oval; red; partially visible through clouds with a glow; corona around the Sun

Figure A.1.4 – Parhelium; multiple suns; fiery cross

Figure A.1.5 – Green ray; solar eclipse; Venus' belt

Table A.1.3 – Solar halo, rainbow, circumzenithal arc

Parameter/ feature	**Description**	**Note**
Observation conditions	From early morning to late afternoon, partly cloudy	
Appearance, main visual features	A halo is an optical phenomenon in the atmosphere caused by the refraction and reflection of light in ice crystals. There are many types of halos, but they are all caused primarily by ice crystals in cirrus clouds in the upper troposphere at an altitude of 5-10 km. It is characterized by the appearance of a secondary glow around a light source, which is usually in the form of a circle, ring, arc, light column or diamond dust. Unlike a rainbow, the circumzenithal arc is caused not by raindrops but by ice crystals, and may resemble an inverted rainbow. The white or hazy rainbow is a wide white rainbow in the sky caused by the scattering of light in very small droplets. The inner side of the white rainbow is slightly tinged with purple, the outer side with orange. The white rainbow differs	Type of halo depends on the shape and arrangement of the crystals. Light reflected and refracted by ice crystals light often decomposes into a spectrum, which makes the halo look like the rainbow. Not visible on the radar. No sounds are heard

Parameter/ feature	Description	Note
	from the usual one (which is formed on large water droplets) due to the fact that the wave properties of light are strongly manifested at a small droplet size. Strong light diffraction occurs on such drops. This causes each colored arc to blur and overlap with the arcs of other colors, resulting in a wide and faintly colored rainbow. Not visible with a thermal imager	
Residual effects, traces	Absent	

Figure A.1.6 – Solar halo

Figure A.1.7 – Red rainbow; concentric rainbow

Figure A.1.8 – Fiery rainbow; rainbow clouds

Figure A.1.9 – Multiple rainbow; cloudlike rainbow (white); circumzenithal arc

Table A.1.4 – Gloria, Brocken spectre

Parameter/ feature	Description	Note
Observation conditions	From early morning to late afternoon, partly cloudy. It surrounds the shadows of objects located in the Earth's atmosphere or on the Earth's surface. It also occurs in the mountains at night if you light a fire under low clouds	
Appearance, main visual features	Gloria belongs to to the group of halos, is observed on clouds located directly in front of or below the observer, at a point directly opposite to the light source. It occurs in specific conditions when highly clustered and highly layered clouds of medium level or fog, the Sun's rays refract in water droplets, creating a spectrum of colors from red to lilac. The gloria surrounds the observer's point of view or the entire object in which observer is located. The angular size of the gloria varies from 5° to 20° and in most cases, it looks like a complete circle. The closer the clouds or fog are to the observer, the larger the gloria. The Brocken spectre is a rare phenomenon in the mountains, when an observer sees his own shadow on the surface of clouds (fog) in the direction opposite to the Sun. This shadow can appear very large, sometimes surrounded by colored rings (just like a gloria). Also, the Brocken spectre can move (sometimes completely unexpectedly) – this is due to the movement of the cloud layer and fluctuations in cloud density. Not visible with a thermal imager	Every observer can see only his own gloria (or a Brocken spectre). Not visible on radar. No sounds
Residual effects, traces	Absent	

Figure A.1.10 – Gloria seeng from the airplane;
Brocken spectre in mountains

Table A.1.5 – Sunlight and shadows

Parameter/ feature	**Description**	**Note**
Observation conditions	Partly cloudy from early morning to late afternoon. Most often sunrise or sunset.	
Appearance, main visual features	In a homogeneous environment, a light beam is a straight line. However, in a heterogeneous medium, the path light can be complex. The direction of light propagation changes when it is refracted or reflected. The light rays diverge equally in all directions from a point light source, which defines a spherical wave. Shadows appear in close cloud cover or in fog behind objects. The observation time is from seconds to several tens of minutes. Can be seen with a thermal imager	The light rays can be observed due to scattered light, if there is enough of scattering centers in the environment. Not visible on the radar. There are no sounds
Residual effects, traces	Absent	

Figure A.1.11 – Sunrise/sunset rays; twilight/dusk rays

Table A.1.6 – The Moon and its visual effects

Parameter/ feature	Description	Note
Observation conditions	Cloudless sky, usually in the evening and at night, early morning	
Appearance, main visual features	The Moon can have different visual appearances, depending on its phases and the conditions of observation. In addition, special visual phenomena occur during eclipses, such as the blood Moon. Its red color is caused by the refraction of sunlight in the Earth's atmosphere. The rays of light that pass through the atmosphere are scattered, and only red hues are visible. The lunar rainbow is an atmospheric optical phenomenon, that occurs when	Not every full Moon leads to an eclipse, because the Moon's orbit is tilted by about 5 degrees relative to the plane of the Earth's orbit around the Sun (ecliptic). Therefore, eclipse is

Parameter/ feature	Description	Note
	the light of the Moon is refracted through water droplets suspended in the air, for example, during rain or near a waterfall. A parselene (false Moon) is a type of halo, an atmospheric optical phenomenon. It occurs due to the refraction of moonlight in flat hexagonal ice crystals in cirrus clouds. Parselenes can occur on both sides of the Moon at a distance of 22° from it. Lunar eclipses occur several times a year; total lunar eclipses are rarer. If the Moon only touches the penumbra of the Earth, then a penumbral eclipse occurs, which is barely visible. It can be seen with a thermal imager	possible only when the Sun, the Earth and the Moon are in the same line during a full moon. Not visible on radar. No sounds are heard
Residual effects, traces	Absent	

Figure A.1.12 – Possible colors of the Moon; lunar partial eclipse; lunar penumbral eclipse; Moon in the clouds

Figure A.1.13 – Lunar halo; parselene; lunar rainbow

Table A.1.7 – Comets

Parameter/ feature	Description	Note
Observation conditions	Cloudless sky, usually in the evening and at night, early morning	
Appearance, main visual features	Visually stationary or a slow-moving (due to optical effects and perception) phenomenon in the form of a light elongated object. Sometimes you can see the tail of a comet – an elongated plume of cometary dust or gas. The comet's tail is formed when the comet comes closer to the Sun and is visible as a result of light scattering on it. Not visible in a thermal imager	As the comet comes closer to the Sun, it heats up and begins to emit gases to form a gravitationally unbound atmosphere around the core, as well as the tail of gas and dust, due to the influence of solar radiation and wind. Not is visible on the radar. There are no sounds
Residual effects, traces	Absent	

Figure A.1.14 – Comets

Table A.1.8 – Meteors, fireballs

Parameter/ feature	Description	Note
Observation conditions	Cloudless skies, usually in the evening and at night, early morning	Brightly colored fireballs
Appearance, main visual features	A meteor is a phenomenon that occurs when small meteoric bodies of cosmic origin burn up in the Earth's atmosphere. The fireball is a large, fiery-bright meteor, a fairly rare phenomenon that looks like a fireball moving in the sky. The meteor body enters the Earth's atmosphere at a speed of 11 to 72 km/s. At this speed, it begins to heat up and glow. Upon entering the atmosphere, the meteor sometimes breaks into fragments, resulting in a meteor shower. The sound may not be audible. With large bolides, there may be an explosive shock wave at close range. The phenomenon lasts a second or less. Can be seen with a thermal imager	If a small body enters into the Earth's atmosphere at a speed of 25 km/s or more, it burns up almost without residue. It is not visible on radar. No sound at long distances

Parameter/ feature	Description	Note
Residual effects, traces	Clouds may remain. If the meteorite is not completely burned up, then a significant amount of energy is released during the impact with the Earth's surface at high speeds (about 2000-4000 m/s), causing the meteorite and part of the rocks at the impact site to evaporate. Out of tens or hundreds of tons of initial mass, only a few kilograms or even grams of material can reach the Earth's surface	The destruction of some bodies has been catastrophic, accompanied by powerful explosions. Often traces no meteorite material remains on the Earth's surface

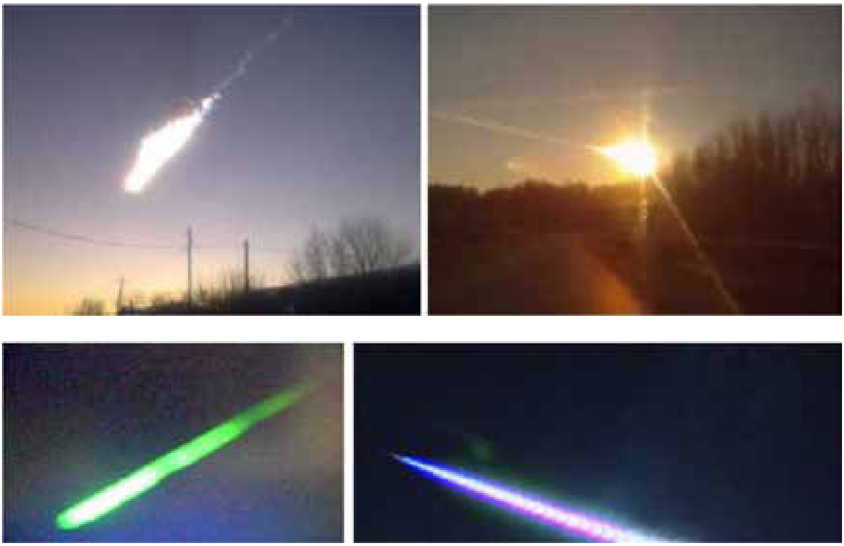


Figure A.1.15 – Bolides

Table A.1.9 – Clouds: lenticular, mushroom, nacreous, silver, biconvex, tubular, wavy cirrus, storm collar, mammatus clouds

Parameter/ feature	Description	Note
Observation conditions	Certain types of clouds appear in certain meteorological conditions	
Appearance, main visual features	Clouds come in different shapes and colors, and may change and metamorphose during observation. The speed of clouds is low, and they can be visually stationary. Lenticular clouds are formed on the crests of leeward waves (waves formed as a result of wind overcoming obstacles). Nacreous (polar stratospheric) clouds form in the sky at high altitudes (about 20–30 km) and consist of ice crystals or supercooled water droplets. Silver clouds are rare cloud-like atmospheric phenomena located in the mesosphere at altitudes between 76 and 85 km. They are visible in deep twilight. They consist of water ice. They are usually observed in summer between 50° and 70° north and south latitude. Cirrus clouds form during the warm season before or after a thunderstorm. They are most often composed of ice crystals or in combination with water droplets. Tubular clouds are quite unusual clouds that look like giant pipes, with colors changing from white to grey and other darker shades.	Clouds – accumulation at a certain height in the troposphere of condensation products of water vapor (water clouds), crystals ice (ice clouds), or a mixture of both (mixed clouds), visible with the naked eye. The formation of clouds related to emergence in the atmosphere of areas with high relative humidity. Usually not visible on radar. No sound is produced

Parameter/ feature	Description	Note
	Storm collar is a type of cumulonimbus cloud resembling a long shaft. Most often, a thunderstorm collar forms at the boundary of atmospheric fronts at an altitude of 100 to 2000 m. It brings with it squalls, showers, thunderstorms, and pressure drops near the ground. Leaky clouds (cavus) – appear in mid-level clouds, consisting of supercooled droplets that do not turn into ice particles due to the lack of nuclei for crystallization. Wavy clouds are a special kind of cloud that look like sea waves. They can be observed in the upper troposphere, are usually evenly distributed and easy to recognize. These clouds are often indicators of atmospheric instability and turbulence. Can be seen in a thermal imager	
Residual effects, traces	As cloud elements consolidate and their speed increases, precipitation falls from the clouds	

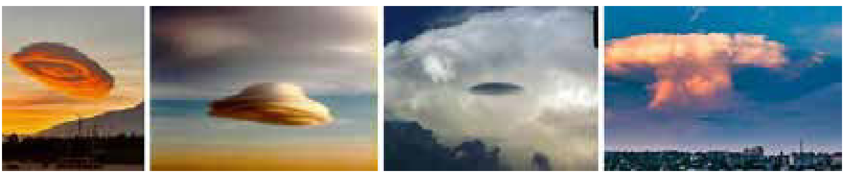


Figure A.1.16 – Lenticular clouds; mushroom-shaped cloud

Figure A.1.17 – Nacreous clouds

Figure A.1.18 – Silver clouds

Figure A.1.19 – Convex or mammatus clouds; tubular clouds

Figure A.1.20 – Wavy cirrus (undulatus asperatus) clouds

Figure A.1.21 – Thunderstorm collar

Figure A.1.22 – Leaky clouds (cavus)

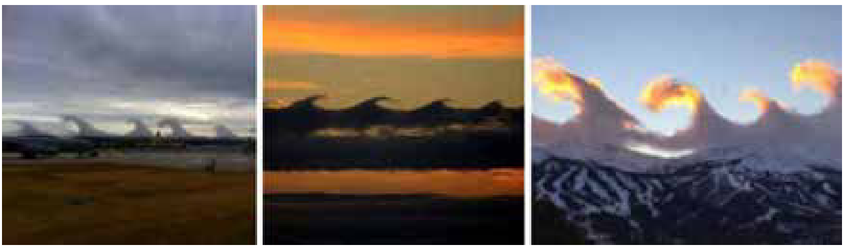


Figure A.1.23 – Wavy clouds

Table A.1.10 – Precipitation, scud, virga

Parameter/ feature	Description	Note
Observation conditions	During the day, cloudy sky	
Appearance, main visual features	Precipitation from clouds occurs as a result of the enlargement of existing cloud elements (droplets or crystals) to a size where they fall from the clouds as droplets with a diameter of more than 0.5 mm and acquire a noticeable fall velocity. Droplets fall out when water droplets coalesce into larger droplets or when water droplets freeze to become ice crystals. Due to the large temperature difference between the cloud and the ground, these ice crystals can melt as they fall to become rain. Scud clouds are a type of broken clouds at low altitude above the ground that have a detached irregular shape and are found beneath stratus, cumulonimbus and high stratus clouds. These clouds often have an irregular or thin appearance. During a thunderstorm, scud clouds often move faster than storm clouds. When in the inflow zone (upward flow), scud clouds tend to rise upwards and can demonstrate significant lateral movement. A virga is precipitation that evaporates before it reaches the earth's surface. The observer sees a visible band of precipitation emerging from the cloud. In thermal imaging it is visible when there is a temperature difference only	The intensity and duration of rain are usually inversely proportional, i.e. the weather is high intensity is likely to be will be short-lived, and the duration of light precipitation can be much longer. Usually not visible on radar. No sounds are produced

Parameter/ feature	Description	Note
Residual effects, traces	The precipitation remains in the form of rain, snow, hail at the place of fall. After tornadoes, precipitation may be accompanied by the fall of various objects or even fish, etc.	

Figure A.1.24 – A wall of rain

Figure A.1.25 – Scud

Figure A.1.26 – Virga

Table A.1.11 – Birds, murmuration

Parameter/ feature	Description	Note
Observation conditions	Birds migrate both during the day and at night, below or above cloud cover	
Appearance, main visual features	Most large birds fly in flocks, often forming regular arrangements of birds in the form of a V-wedge, a line, etc. Murmuration is a coordinated flight of huge flocks of birds that form three-dimensional dynamic figures of variable density, shape, and outline. This is a phenomenon that has not yet been explained or studied. Birds migrate no higher than a certain height at a certain speed. Visible through a thermal imager	Maybe visible on radar. Sounds are usually not heard from a considerable distance, Birds can be heard calling from close quarters
Residual effects, traces	None. There may be bird droppings over the masonry site	

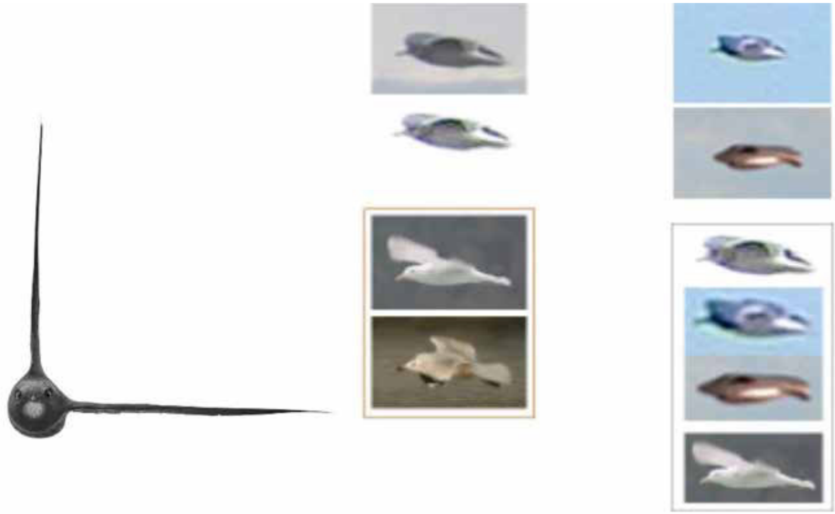


Figure A.1.27 – Various views of a single birds

Figure A.1.28 – Glare of birds at night from natural/artificial light sources; wedge of birds

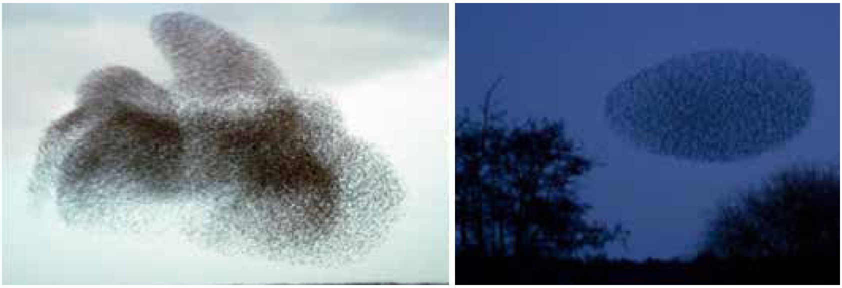


Figure A.1.29 – Murmuration of birds

Table A.1.12 – Insects, swarming

Parameter/ feature	Description	Note
Observation conditions	Below cloud cover, usually in the non-winter season	
Appearance, main visual features	Single insects or groups of them are usually not visible in optoelectronic devices and surveillance equipment, they can be detected after the fact in photos and videos as blurred objects out of focus. Under the infrared illumination of night vision devices, insects can be observed as bright, fast-moving objects. Flocks and swarms of insects are visible to the naked eye during the day as amorphous, changing clouds. They are visible only up close through a thermal imager	Dense compact swarms of insects can glow in electrified atmosphere. Usually not visible on radar. Insect sounds can be heard up close, for flocks, swarming – can be heardfrom considerable distance
Residual effects, traces	Residual effects are absent in the sky. After flocks and swarms of insects, their bodies and traces of activity may remain on the ground	

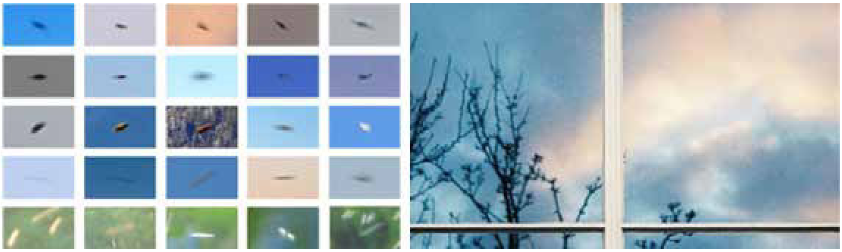


Figure A.1.30 – Photographs of individual insects; swarming insects

Table A.1.13 – Light pillars

Parameter/ feature	Description	Note
Terms of observation	Observed in the sky during sunset or sunrise	
Appearance, main visual features	The phenomenon occurs when rays of light (usually sunlight) are reflected from small ice crystals suspended in the air. A visual atmospheric phenomenon, an optical effect that is a vertical streak of light. Light pillars often form around the moon, city lights and other bright light sources. They look like stationary pillars in the air. Not visible with a thermal imager	Not visible on radar. No sounds are detected
Residual effects, traces	Absent. After the end of the observation, the vertical poles fade after a while	

Figure A.1.31 – Light pillars

Table A.1.14 – Aurora Borealis

Parameter/ feature	Description	Note
Terms of observation	Cloudless skies, usually in the evening and at night, during magnetic storms, significant solar activity accompanied by coronal mass ejections from the Sun	With growth of solar activity Aurora Borealiscan occur not only in northern but also in temperate latitudes
Appearance, main visual features	A rapidly changing optical phenomenon of glowing in certain areas of the night sky in polar regions. It occurs in the upper atmosphere under the influence of streams of charged particles that the Earth's magnetic field directs towards the poles. Can be seen in a thermal imager	Not visible on radar. No sounds are detected
Residual effects, traces	Absent	

Figure A.1.32 – The Aurora Borealis

Table A.1.15 – Sprites, elves, blue jets

Parameter/ feature	Description	Note
Terms of observation	Cloudless skies, usually in the evening and at night. High observation height	
Appearance, main visual features	Sprites, elves, blue jets are electrical discharges, i.e. high-altitude lightning. These are short-lived light phenomena in the upper atmosphere at an altitude of 30, 50 and even 100 km. Visible in a thermal imaging camera	In the upper atmosphere, there are many other poorly understood lightning that is electrically induced types of luminous plasma. Not visible on radar. No sounds are heard
Residual effects, traces	Absent	

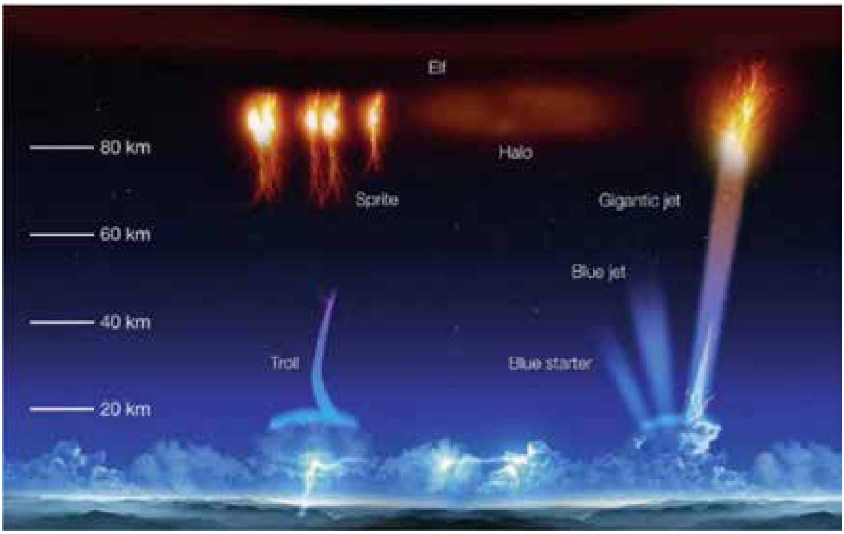


Figure A.1.33 – Types of high-altitude atmospheric electric discharges

Figure A.1.34 – Sprites

Figure A.1.35 – Elves

Figure A.1.36 – Blue jets

Table A.1.16 – Mirage, morgana veil

Parameter/ feature	Description	Note
Terms of observation	As a rule, it is visible during the daytime, but conditions for the appearance of a mirage can also occur at night. A precondition is a temperature difference in the air layers over flat, extended surfaces	
Appearance, main visual features	An optical ground phenomenon in the atmosphere: the refraction of light fluxes at the boundary between air layers with sharply different densities and temperatures. For an observer, this phenomenon means that, along with the actually visible distant object (or part of the sky), its reflection in the atmosphere is also visible. At the same time, the original object may not be visible due to the observation conditions. A morgana veil is an optical phenomenon in the atmosphere made up of several forms of mirages. Not visible in a thermal imager, unlike the original object	Not visible on radar. No sounds are detected
Residual effects, traces	Absent	

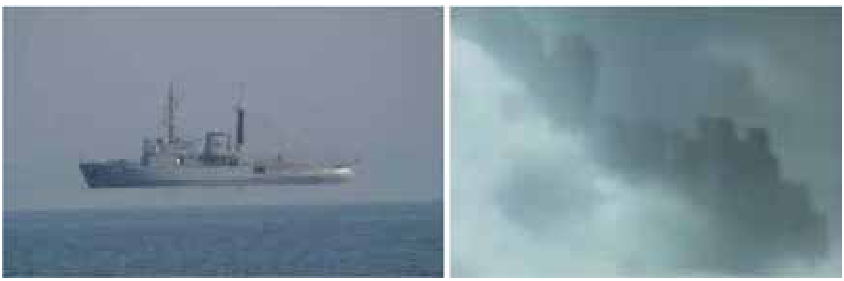


Figure A.1.37 – Mirage; morgana veil

Table A.1.17 – Smoke, steam, solitons

Parameter/ feature	Description	Note
Terms of observation	Below cloud level	
Appearance, main visual features	Natural plumes of smoke (e.g. from wildfires) can spread over the ground, changing shape and structure, and outline. A steam can condense from air, turning into clouds or fog, rising from the ground, swirling in ravines, gorges, etc. Solitons are ring-shaped clouds that rise gently upwards. Can be seen in a thermal imaging camera at different temperatures	Not visible on radar. No sounds are detected
Residual effects, traces	None. Water vapor can pass directly into water and into the solid phase - ice , crystals falling as precipitation	

Figure A.1.38 – Natural solitons in the air environment

Table A.1.18 – Tornadoes, whirlwinds, firestorms, dust storms, typhoons

Parameter/ feature	Description	Note
Terms of observation	Within a day. Typhoons can form and exist only over a large water surface, and they quickly lose strength over land	
Appearance, main visual features	Tornadoes – is phenomenon in which a vortex wind (a vertically oriented rotating column of air) is formed from micro gusts due to instability and turbulence caused by heating and flow gradients. Tornadoes can vary in size and last from a few minutes to several hours. When the tornado's arms catch fires, they become fire whirlwinds. A dust storm is an atmospheric phenomenon in the form of wind-borne dust (a large amount of dust, soil particles, and grains of sand) from the earth's surface in a layer several meters high with a noticeable deterioration in horizontal visibility. A typhoon is a mass of low-pressure air vortex that forms over a warm sea surface. Visible in a thermal imaging camera at different temperatures	Usually, it is not visible on the radar. The sounds of a tornado are only heard on the close and average distances
Residual effects, traces	At the point of contact to the surface, a cascade may occur – a cloud or column of dust, debris and objects raised from the ground or from the water	

Figure A.1.39 – Micro vortex – a type of squall; formation of a tornado

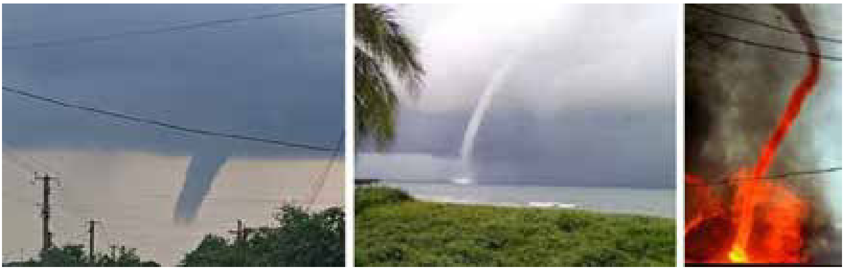


Figure A.1.40 – Tornado; firestorm

Figure A.1.41 – Typhoon

Figure A.1.42 – Dust storms

Table A.1.19 – Fog, mist, haze, smog

Parameter/ feature	Description	Note
Terms of observation	Water droplet fogs occur mainly at air temperatures above -20 °C, but can also occur at temperatures below -40 °C. At temperatures below -20 °C, ice fogs prevail. In the mountains, fogs are indistinguishable from clouds, so the phenomenon of fogs is mainly confined to the plains	The fogs in populated towns and cities occur more often than outside them. This is due to the increased content of hygroscopic nuclei of condensation (dust, soot, etc.)
Appearance, main visual features	Fog is an atmospheric phenomenon, accumulation condensation products of water vapor (water droplets, ice	Haze often confused with fog, because it is

Parameter/ feature	Description	Note
	crystals or a mixture of both) suspended in the air directly above the earth's surface, in the surface layer of the atmosphere. Fog causes air turbidity that reduces horizontal visibility to 1 km or less. Frontal fog – appears in atmospheric fronts where cold air is saturated with moisture. Haze – air turbulence caused by the presence of water vapor condensation products (moisture droplets, ice crystals), suspended dust particles, smoke, and burning. Visibility ranges from 1 to 9 km. Haze reduces visibility less than fog, but more than haze. It is characterized by less than 2 km of visibility but more than 1 km. Haze is a light mist fog and light transparent air turbidity caused by the presence of condensation products, such as small water droplets or ice crystals. The visibility range is 1–10 km, and the relative humidity is in the range of 58–100 %. The condensation and sublimation products of water vapor (droplets and crystals) scatter the sun's rays, so objects acquire a whitish-greyish color and fuzzy outlines. Smog is an aerosol, that consists of from smoke, fog and dust. Visible in a thermal imaging camera at different temperatures	almost impossible to tell the difference between them. Relative humidity of fog is almost 100 %. Fog is also called dry haze. It consists of smoke, dust and sand, and its humidity is less than 50 %. Not visible on radar. No sounds are detected
Residual effects, traces	Not present in the atmosphere. Suspended particles can settle and condense on the surfaces of objects	

Figure A.1.43 – Frontal fog

Table A.1.20 – Lightning

Parameter/ feature	Description	Note
Terms of observation	During a thunderstorm	Ball lightning is an anomalous aerospace phenomenon and should be considered separately
Appearance, main visual features	Conventional lightning – ground-cloud, cloud-ground, cloud-cloud – is formed in the lower atmosphere at an altitude of 12-16 kilometers. Ribbon, bead (dotted), rosary lightning are less common. The color is usually bright	Not visible on the radar. Rolling sounds of thunder can be heard from a distance

Parameter/ feature	Description	Note
	white, yellow, blue, purple, depending on cloud cover and weather conditions. The lifetime is up to 1-3 seconds. Visible through the thermal imager	
Residual effects, traces	Not present in the atmosphere. After discharge, a trace of electrification may remain	

Figure A.1.44 – Ordinary lightning; lightning in the clouds

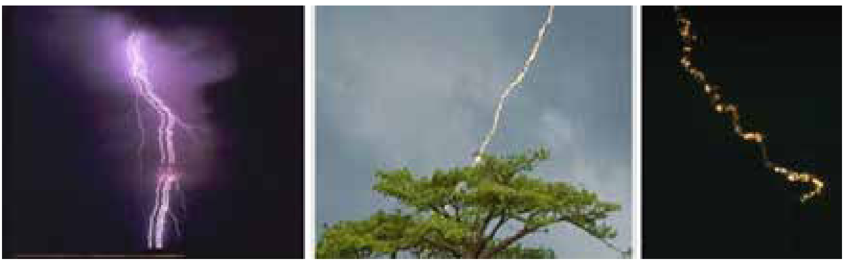


Figure A.1.45 – Lightning: tape; beaded (dotted); rosary

Table A.1.21 – The St Elmo’i fire

Parameter/ feature	Description	Note
Terms of observation	In stormy weather. The lights usually appear when the peak of the storm is over	
Appearance, main visual features	Quite long electric discharge that occurs at high intensity of the electric field in the atmosphere in the form of shining beams at the sharp ends of tall objects. A blue, green or purple glow is accompanied by crackling sound. For physical nature, these discharges are a special form of corona discharge. Discharges can only move with the source, tied to an object. Visible in a thermal imager	Not visible on radar. No sounds are detected
Residual effects, traces	Absent	

Figure A.1.46 – The St Elmo`s fire

Table A.1.22 – Luminescence in flora and fauna

Parameter/ feature	Description	Note
Terms of observation	Cloudless skies, usually in the evening and at night	
Appearance, main visual features	A natural phenomenon of biological origin, which occurs when the surface layers are filled with microorganisms capable of bioluminescence, making the object seem to glow from the inside. Varieties of plants, fungi, etc. can also glow. It can look like a pulsating low-flying object on the horizon of blue, blue, red, green colors, with a variable outline. Insects can glow yellow, orange, green, and form swarms. As a rule, they are not visible in a thermal imager	The glow in the sea sometimes covers vast territory up to hundreds or even thousands of square kilometers in the form of spots, chains and clusters. Not visible on radar. No sounds are heard
Residual effects, traces	Absent	

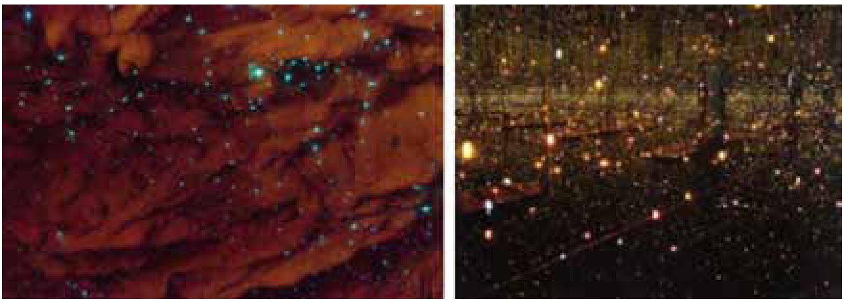


Figure A.1.47 – Glowing of fireflies

Figure A.1.48 – Bioluminescence: in the sea; on hills

Table A.1.23 – Methane glow

Parameter/ feature	Description	Note
Terms of observation	Cloudless skies, usually in the evening and at night	
Appearance, main visual features	Flickering flying or stationary lights that may be ignited by a fire source. The color of this light (fire) can vary from ghostly white, blue or greenish to the color of a living flame, without smoke. Visible in a thermal imaging camera	Not visible on radar. Characteristic sounds can only be heard up close
Residual effects, traces	Absent	

Figure A.1.49 – Stray lights; gas luminescence; methane combustion

Table A.1.24 – Natural fires, campfires

Parameter/ feature	Description	Note
Terms of observation	Ground phenomena in variable terrain can appear as low-hanging objects	The natural causes of fires are spontaneous combustion at heat waves, lightning strikes, fire tornadoes, meteorite impacts
Appearance, main visual features	Bright burning of variable shape and brightness, warm colors can appear as a pulsating light object from a distance. Burning can last for several hours or even days. The outline is blurred. There is no movement, but there may be polymorphism. The observation angle is low. Clearly visible in a thermal imager	Zoom allows you to identify a fire even from significant distance. Not visible on radar. Combustion sounds are heard only from a short distance
Residual effects, traces	Smoke can remain for many days due to smoldering, there are many signs of fire at the site	

Figure A.1.50 – Natural forest fire in the distance; peat bog burning; diffuse light from the fire

Table A.1.25 – Light reflections of natural objects

Parameter/ feature	Description	Note
Observation conditions	The natural light source is directed counter to the natural reflector. Natural reflections are observed mainly from stationary objects such as crystals, ice, water, etc.	Image edges on the retina appear blurred if the light source is located close to the line of sight of the observer. It makes it harder to observe and reduces the visibility of objects
Appearance, main visual features	It is an element of light shade, a light spot on brightly lit convex or flat glossy surface. It occurs as a result of specular or specular-diffuse reflection of a bright light source, most often it is the Sun shade on the objects. A bright object or several, with a smooth appearance/disappearance in natural light depending on the observation conditions. The observation time can be considerable. The outline can be defined. Dimensions can reach kilometers. Observation angle is low. Not visible in a thermal imager	The natural glow can give only a few natural objects that have reflective surfaces (water bodies, snow, ice, natural outcrops brilliant stones such as quartz). Not visible on radar. No sounds are heard
Residual effects, traces	None. Objects can be identified when approaching them	

Figure A.1.51 – Sun glare from water from an airplane; ice glare; glare of snow in the mountains

Annex 2

PARAMETERS AND FEATURES FOR IDENTIFICATION OF AEROSPACE OBJECTS AND PHENOMENA OF ANTHROPOGENIC ORIGIN

Table A.2.1 – Ballistic and space missile launches

Parameter/ feature	Description	Note
Observation conditions	Cloudless skies, usually in the evening and at night	
Appearance, main visual features	In the first few minutes an inversion trail is observed near the horizon (angular height 3–30 °) following a moving bright light point. The jets of escaping gases can be seen in the form of rays. When launch observed from the outside, the shape may resemble a whale or flounder with a luminescent area. It usually has a drop-shaped trajectory. The outline is blurred. Color varies, often white and blue. The speed can be visually estimated as a jet aircraft at a distance of several kilometers away. Observation through a thermal imager is difficult	Bright luminosity trace and gases is caused partly by self-luminescence, and largely by their sunlight due to the high altitude above the earth's surface (50–200 km) and due to the refraction of the rays. Movement is usually not detected on radar. Due to the long distance, sounds are usually missing
Residual effects, traces	Absent. After the end of the observation of the movement of the light point (up to 10 min), a rather rapid (5-15 min) dispersion of gases with their intense glow occurs, which gradually (after 1-3 hours) weakens and disappears	

Figure A.2.1 – Variety of space rocket launches effects

Figure A.2.2 – Launch effects; Ariane 6 rocket in the sky

Figure A.2.3 – Launch of two Maxar Worldview Legion satellites; the second SpaceX Falcon 9 carrier stage

Table A.2.2 – Movement of artificial satellites in Earth orbit, spacecrafts

Parameter/ feature	Description	Note
Observation conditions	A cloudless sky. There may be a sudden appearance when leaving the Earth's shadow	In cloudy conditions, the flight may be partially visible in areas of clear sky
Appearance, main visual features	There may be parts of the trajectory with periodic activation of the correction engines, which create short-lived glow jets of ionizing gas, periodic changes in the satellite’s brightness due to the lack of stabilization of its position in orbit. No noticeable acceleration, smooth motion, gradual change in brightness and color at night when entering the Earth's shadow. Speed is up to 7.8 km/s. It cannot hover or change trajectory. It can be observed up to several minutes, with possible cyclical reappearance after orbiting the Earth.	There can be two-three flying satellites, like Starlink, when launched from a carrier. They can be misidentified as a single long object with lights. The objects are not detected by conventional radar. There are no sounds

Parameter/ feature	Description	Note
	Color from whiteto orange, possible flickering and iridescence due to atmospheric effects. The outline is blurred. The shape is visually spherical. Angular size is less than 1 degree. Height from several hundred kilometers to hundreds of thousands. Usually not visible in a thermal imager	
Residual effects, traces	None	

Figure A.2.4 – Satellite flight path: Iridium; Starlink

Table A.2.3 – Combustion of space debris, landing of spacecraft during reentry into dense layers of the atmosphere

Parameter/ feature	Description	Note
Observation conditions	Cloudless sky	In cloudy weather, you can only see fragmental trajectories of body movement
Appearance, main visual features	The motion during the burning of a satellite or launch vehicle in the atmosphere often looks like the movement of a group of multi-colored light bodies in the form of a swarm, usually without a noticeable change in mutual distances during observation (1-3 minutes). The color is usually white and uniform. There are possible short-lived numerous flashes and changes in brightness due to particle disintegration and combustion characteristics. Burning bodies are stretched in the direction of movement (due to the difference in mass and shape of individual parts) by an angular size from units to tens of angular degrees. The trajectory of combustion is close to horizontal. Trajectory changes and hovering are not possible. The movement of a group of bodies occurs without acceleration, smoothly, at speeds up to several km/s. The height is 50–110 km. Visible with a thermal imager	During the landing of modules or reusable spacecraft, a single bright luminous body is observed. It is sometimes accompanied by several small bodies (elements). For spacecraft, the controlled landing at the final part of the trajectory looks like an aircraft or a capsule on a parachute. The movement is usually not detected by radar. There are no sounds
Residual effects, traces	None. The controlled drop site is usually located in the ocean	Remains cannot be detected by an observer

Figure A.2.5 – Burning of spacecraft debris in the atmosphere

Figure A.2.6 – Space Shuttle and Starship reentry into the dense layers of the of the atmosphere

Table A.2.4 – Missiles and bombs launches

Parameter/ feature	Description	Note
Observation conditions	Areas close to the frontline, places of operation of air defense systems, military training, exercises etc.	Missiles can be launched from air, land and sea. Bombs are dropped from aircraft
Appearance, main visual features	Smoke trail produced by missiles at launch, flame plume in flight on the initial part of the trajectory. No light effects for bombs. The outline is clearly	They can be detected on radar. Bombs have no sound; missiles

Parameter/ feature	Description	Note
	defined. The shape is elongated, cigar-shaped. Bombs, including glide bombs, look like separate bodies with a predominantly horizontal fast flight. There may be smooth changes in trajectory with acceleration and/or braking. Dimensions usually various: 2–12 m. Ballistic missile flight altitude up to 50 km. Maximum speed 8800 km/h. Missiles are visible through a thermal imager, with a distinct plume	produce the sound of an engine hearable from a distance of up to 1–2 km
Residual effects, traces	Inversion trails in the sky from carrier jets can be observed in the sky for about an hour, drifting downwind	Missile launches from the air also leave inversion traces

Figure A.2.7 – Air launches of missiles; multiple missiles launches

Figure A.2.8 – Naval missile launch; multiple missiles launchs from a marine drone, filmed on a thermal camera

Table A.2.5 – Lighting from lanterns, sources on structures and buildings

Parameter/ feature	Description	Note
Observation conditions	Usually observed in the dark, in some weather and other conditions (rain, drizzle, etc.) that make identification difficult	
Appearance, main visual features	Stationary bright light sources, without movement. They are ground-mounted and can be installed on towers, devices, buildings. Angular height is up to several degrees. The observation time can cover hours, until the source is switched off. They can be directional, can have a beam or beams. Brightness can vary due to the characteristics of the source and terrain details, and may sway in the wind. Angular size is less than 1 degree. The outline depends on the observation conditions and the type of source. Visible with a thermal imager	Approaching to facility and/ or changes in weather conditions or time of the day allow you to identify. On the radar it can be detected as structure where a light source is located. Sounds are absent.
Residual effects, traces	Absent	

Figure A.2.9 – Street lighting lanterns

Figure A.2.10 – Lighting lights on a crane; on a water tower

Table A.2.6 – Lighting from headlights on land vehicles

Parameter/ feature	Description	Note
Observation conditions	In the dark, in conditions of limited visibility, and adverse weather conditions. Ground observations, with changing terrain and difficult visibility conditions. It may appear during low-flying.	Search activities with the use of artificial light sources can be carried out during the day also
Appearance, main visual features	They are smoothly moving light sources. They can be visually stationary when moving towards the observer or when the vehicle is stopped. Headlights can rotate on a fixed source, the brightness can change depending on movement, turns, terrain details. The color can be varied, including variable (e.g. flashing beacons). Disappearance and reappearance may be abrupt due to variability in the visibility zone and/or when the light source is switched on/off. The linear dimensions of one headlamp are less than 1 meter. Speed is usually up to 100 km/h. The movement is ground-based. Visible in the thermal imager	The sound of the engine is heard depending on the conditions and distance. Ground movement can be detected only by special radar systems
Residual effects, traces	Absent	

Figure A.2.11 – Car headlights in fog

Table A.2.7 – Lighting from sources on aircraft and unmanned vehicles

Parameter/ feature	Description	Note
Observation conditions	Usually, they are observed in the dark, with limited visibility, adverse weather conditions. Search activities during the day. For civilian aircraft, headlights are mandatory when landing, and on-board navigation lights must be switched on at all times	Civil aviation flights are prohibited in Ukraine during martial law; military aircraft can be used without headlights and aeronautical lights for light camouflage purposes
Appearance, main visual features	They are smoothly moving light sources. They can be visually stationary when moving towards the observer (aircraft) or stopped, hovering (quadcopter, helicopter). The headlights can be rotated on a fixed source; the brightness can be changed depending on the movement and terrain details.	Aircraft and large UAVs are visible on radar, but small UAVs require special detection systems detection systems.

Parameter/ feature	Description	Note
	Disappearance and reappearance may be abrupt due to the variability of the visibility zone and/or when switching the source on and off. Speed and altitude are equal to the speed and altitude of the carrier. Visible in the thermal imager	Depending on the conditions and distance, it may be audibly sound of work engine
Residual effects, traces	Absent	

Figure A.2.11 – Car headlights in fog

Figure A.2.13 – Searchlights on quadcopter

Table A.2.8 – Cruise missiles

Parameter/ feature	Description	Note
Observation conditions	They are observed over the entire territory of Ukraine during martial law, mainly during russian air raids. Best visible during daylight hours	The missiles can be observed outside of air traffic control under time of testing at or near landfills and combat missile attacks on the enemy by air defense units
Appearance, main visual features	The outline is clearly defined. Cigar-shaped, sometimes the engine and stabilizers can be distinguished separately. The color is dark against the sky; the actual color can be light or white. The lowest flight altitude is 20 m above the sea surface and 50–150 m above the ground. Speed is subsonic, averaging 180–240 m/s, but can reach Mach 2. Length up to 10 m. Visible in a thermal imager	Visible on the radar, except for ultra-small heights. At close distances they produce audible distinctive sound of engine operation. Cruise missiles can shoot off thermal traps and can have dipole reflectors
Residual effects, traces	Practically absent. In most cases, the inversion mark is absent or very weak. For the effects of impacts and knockdowns, see separately below	

Figure A.2.14 – Single cruise missile flight; cruise missile group flight

Figure A.2.15 – Low cruise missile overflight over water;
view of the missile in thermal imager

Table A.2.9 – Illuminating and incendiary bombs and shells

Parameter/ feature	Description	Note
Observation conditions	Areas close to the frontline, places of operation of air defense systems, training, exercises. Best visible in the dark	Bombs are dropped from aircraft that are not always visible
Appearance, main visual features	Color may vary. The outline of the light source is blurred. Thanks to the parachutes, the lighting bomb can stay in the air for up to several tens of minutes. There is a gradual decrease, fading, sparking and falling of light parts. There can also be manifestations in the form of a single bright flash, mostly white. The angular speed is up to several degrees/s. The movement is uniform or with smooth acceleration/deceleration. Clearly visible in a thermal imager due to its high temperature	Group applications are possible. The configuration is arbitrary. Bursting sounds depend on the distance. When burning, sounds are usually inaudible. Possible detection on radar
Residual effects, traces	Smoke clouds may remain in the sky, illuminated by other objects or light sources, drifting for hours in the wind. There may be fallen remnants of combustion, parachutes on the ground	

Figure A.2.16 – Ignition, phosphorus charges

Figure A.2.17 – Illuminating aerial bombs; illuminating artillery shells

Table A.2.10 – Signal rockets

Parameter/ feature	Description	Note
Observation conditions	Below cloud cover	
Appearance, main visual features	The rocket's motion is vertical during the initial climb, followed by a parabolic fall until the braking parachutes open. The fire pattern is characterized by spontaneous rapid fluctuations in brightness. A slow drift of a group of illumination rockets, suspended on parachutes in the wind. They can have different colors. Angular speed up to several degrees/s. The movement is uniform or with smooth acceleration/ deceleration. Visible in thermal imager, combustion temperature up to 2000 Celsius degrees	You can also observe groups of flares, that are lit sequentially. Not visible on the radar. There is not sound
Residual effects, traces	Relatively short burning time of the rockets (units of seconds for rockets and tens of seconds for illuminating rockets). Traces of smoke during combustion and after stop are clearly visible for up to several hours, carried away by the wind	Remains of rockets and parachutes can be found at the crash site

Figure A.2.18 – Signal rockets

Table A.2.11 – Fireworks and firecrackers

Parameter/ feature	Description	Note
Observation conditions	Below cloud cover	Launching salutes, fireworks and use of firecrackers during martial law is banned throughout Ukraine
Appearance, main visual features	Vertical rise of single light sources, followed by explosions with sharp expansion. Secondary and multiple tears and sparking are possible. They can have different colors. The shape is spherical. They can appear as hemispheres on the horizon. Visible in a thermal imager, high combustion temperature	Not visible on radar. Sounds of airborne explosions can be heard at a distance of several kilometers
Residual effects, traces	The duration of the explosions is very short, but due to the number of consecutive explosions, it can last for minutes. Clouds of explosive debris remain in the air, drifting in the wind	Burned paper remains and plastic parts can be found at the crash site

Figure A.2.19 – Fireworks; fireworks from a swarm of drones

Table A.2.12 – Sky lanterns

Parameter/ feature	Description	Note
Observation conditions	Below cloud cover. Sky lanterns are usually not launched in windy and rainy weather	
Appearance, main visual features	They move in the wind and there can be fluctuations in brightness. They do not have their own engine, so abrupt trajectory changes and rapid acceleration are not possible. Visual hovering is possible when moving towards or away from the observer. The outline is generally well defined. Dim light of a warm hue also depends on the color of the shell. The shape is varied but it is aerodynamic and closed. Multiple simultaneous launches are possible. Visible through a thermal imager, burning temperature up to 100–120 Celsius degrees. Typical dimensions are approximately 1 meter in height and 60 cm in diameter	There are no sounds. When they encounter an obstacle (tree, building), they can hang on to it or fall abruptly. The shell can also burst into flames. Not visible on radar
Residual effects, traces	The maximum observation time is 15–20 minutes.	At the crash site you can find burned paper remains, plastic parts, wire

Figure A.2.20 – A group of sky lanterns; view of a sky lantern in a thermal imager

Table A.2.13 – Aircrafts

Parameter/ feature	Description	Note
Observation conditions	The probability of observation is lower in adverse weather conditions and darkness	Civil aviation flights are prohibited in Ukraine during martial law
Appearance, main visual features	Possible acceleration, deceleration, performing aerial tricks with turning radii and speeds specific to each type of aircraft. The outline is clearly defined. The color is varied, as a rule it is light monochromatic underneath, with protective coloring on top. Flight altitude is up to several kilometers (several tens of kilometers for stratoplanes), and in combat conditions, flights at ultra-low altitudes of up to several tens of meters are possible. They move fast, visual hovering is possible when moving in the plane of the observer, up to tens of minutes, short-term hovering when moving upwind. Landing usually does not occur, but a visual appearance of landing is possible when going over the horizon. Visible through a thermal imager, turbojet engine temperature 600-850 °C	Characteristic sounds of the engine can be heard from a distance of several kilometers, depending on the observation conditions. Visible on radar
Residual effects, traces	Inversion trails in the sky from jet aircraft can sometimes remain for a long time, drifting in the wind	

Figure A.2.21 – Main combat aircrafts of the Ukrainian Air Force: Su-27, MiG-29, Su-25, Su-24M, F-16, Mirage 2000

Figure A.2.22 – russian combat aircraft Su-27, Su-35S

Figure A.2.23 – russian Su-30SM and Mig-29 combat aircraft

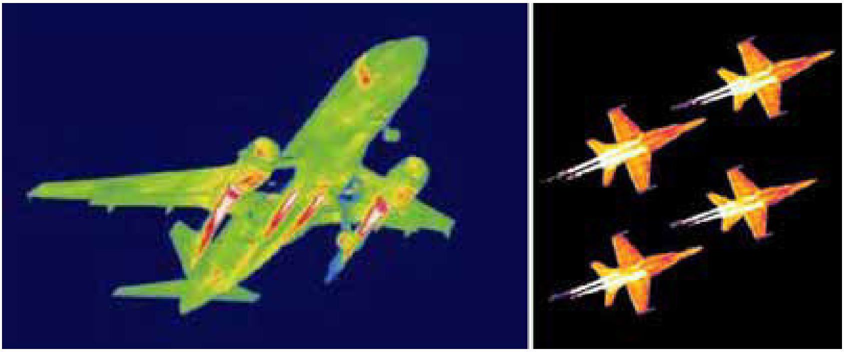


Figure A.2.24 – View of transport plane and combat aircraft through a thermal imager

Table A.2.14 – Helicopters, gyroplanes

Parameter/ feature	Description	Note
Observation conditions	The probability of observation is lower in adverse weather conditions and in the dark	Civil aviation flights are prohibited in Ukraine during martial law
Appearance, main visual features	Helicopters and gyroplanes move horizontally, can hover over one point for up to several tens of minutes, rotate around their axis, and perform aerial tricks in a limited way. Can have on-board aeronautical lights. Landing is possible anywhere on flat empty land. The outline is clearly defined. The color is varied, usually it is light monochrome on the bottom and protective coloration on the top. Flight altitude is up to several kilometers; in combat conditions, flights at ultra-low altitudes of several tens of meters are possible. Visible through a thermal imager	Characteristic sounds of the engine can be heard from a distance of several kilometers, depending on the observation conditions. Visible on radar
Residual effects, traces	Absent	

Figure A.2.25 – Gyroplanes

Figure A.2.26 – Identification of Ukrainian helicopters and enemy helicopters by special markings, type, color and outline

Figure A.2.27 – Helicopter; thermographic image of a helicopter

Table A.2.15 – Stratospheres, weather balloons

Parameter/ feature	Description	Note
Observation conditions	Visible during launch or landing, in the stratosphere, they are almost invisible from the ground due to their long range. It is difficult to distinguish them, or they may not be visible in a low, dense cloud cover.	
Appearance, main visual features	Mostly spherical objects of light, mostly white, color suspended from a rope. The outline is clearly defined. There can be a suspension in the form of a box, there can be solar batteries. They move slowly downwind. The flight altitude of weather balloons is 30-40 km (maximum ~53.7 km). Visible through a thermal imager only in a short distance	It should be kept in mind that the wind direction may vary at different heights, in including the opposite; speed may significantly differ. Poorly visible on radar due to the small effective scattering area (hereinafter referred to as ESA). There are no sounds

Parameter/ feature	Description	Note
Residual effects, traces	A stratospheric balloon bursts at the maximum altitude, after which the balloon falls or is lowered by parachute. Remains of the balloon, suspension and parachute can be found at the crash site	

Figure A.2.28 – Research stratospheric balloon; weather balloon; stratospheric experimental drone (USA)

Table A.2.16 – Hot air balloons and airships

Parameter/ feature	Description	Note
Observation conditions	As a rule, air balloons and airships are not used in bad weather and at night. They are large and visible from a long distance	
Appearance, main visual features	Hot air balloons, that are secured to the ground by ropes or cables, have little movement and the rope can be visible. The shape is three-dimensional, can be varied, but aerodynamically stable. The color is of any kind. Aeronautical and other lighting can be present. Airships and hot air balloons have a suspended gondola. Airships are steerable and capable of moving against the wind, takeoff and landing can be manned or unmanned. The observation time is several hours or even days for stationary balloons. Balloon engines and flames are clearly visible in the thermal imager.	Poorly visible on radar due to low ESA (unless the ballon material is metallized). Sound is usually inaudible due to low engine power (airships)
Residual effects, traces	Absent	

Figure A.2.29 – Military balloons

Figure A.2.30 – Hot air balloon; burning of hot air balloon

Figure A.2.31 – Balloon with a corner reflector (false target);
tethered observation balloon

Table A.2.17 – Balloons

Parameter/ feature	Description	Note
Observation conditions	Observed below cloud cover at low altitude	
Appearance, main visual features	Small objects can be combined into groups or clusters with synchronized movement. The shape can be varied, but aerodynamic. The color can be different. There can be internal or external lighting, and glare from natural and artificial external light sources. They move slowly in the wind, visually hovering when moving towards or away from the observer. They can slowly gain height or go downward. Balloons are visible only from a short distance through a thermal imager. The metamorphosis of the object can be visible.	It should be borne in mind that the wind direction at different heights can be different, including the opposite. The speed may vary. Sounds are absent. Balloon is not visible on radar due to its low ESA, unless the surface is not metallized.
Residual effects, traces	There are no traces during flight. When falling, balloons or their debrees remain on the ground. Balloons can also cling to trees and structural elements.	

Figure A.2.32 – Multiple balloons glossy in the sunset; a bunch of balloons with synchronized movement; a bunch of balloons with LEDs

Table A.2.18 – Leaflets, dipole reflectors

Parameter/ feature	Description	Note
Observation conditions	They are dropped from military aircraft. Leaflets are intended to inform the public.	
Dipole reflectors are dropped to create false targets on radar	Due to the fast flight, the launch vehicle may not be visible during observation	
Appearance, main visual features	From a distance, it may appear as a shapeless amorphous mass of dots or small objects. The carrier cannot be visible due to the speed of the flight. For leaflets, color varies; for reflectors, color is metallic or dark. Non-visible in a thermal imaging camera.	Leaflets are not visible on the radar, but reflectors create the appearance of many changing objects. There are no sounds
Residual effects, traces	Dipole reflectors look like small, thin strips of metal that can be found in big quantities over a large scattering area	

Figure A.2.33 – Leaflet dropped from a UAV;
dipole reflectors dropped from an aircraft

Table A.2.19 – Kites, parachutes, paragliders, hang gliders

Parameter/ feature	Description	Note
Observation conditions	Windy weather, mainly during the day for kites. Parachutes can be numerous	Kites with reflective material or their own lights can be visible at night
Appearance, main visual features	A characteristic effect of kites is the presence of a tether to the launch site. Paragliders and hang gliders can have engines, move against the wind, and hover visually. The colors are different. The speed does not exceed the wind speed at the height of flight. In some cases, kites can break away and then move downwind	Barely visible on radar. Sounds from the engine are only audible from a short distance
Residual effects, traces	None. When dropped, residues remain in the form of plastic parts, ropes, etc.	

Figure A.2.37 – Paragliders

Figure A.2.34 – Various forms of kites

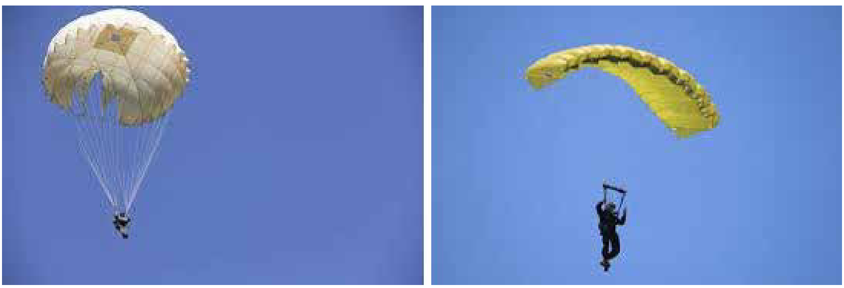


Figure A.2.35 – Parachutes for people

Figure A.2.36 – Parachute for UAV landing; bomb with parachute

Figure A.2.38 – Hang gliders

Table A.2.20 – Aircraft-shaped UAVs

Parameter/ feature	Description	Note
Observation conditions	Probability of observation is lower during adverse weather conditions – wind, rain, drizzle	Civilian UAVs are not allowed to fly in in Ukraine in a period of martial law
Appearance, main visual features	They can accelerate, decelerate and perform aerial tricks with turning radii and speeds specific to each type of aircraft. Wingspan is up to 20 m. The outline is clearly defined. The color is varied. Can be equipped with specific	The typical engine sounds can be heard from a distance of several kilometers,

Parameter/ feature	Description	Note
	onboard lights. Flight altitude is up to several kilometers; in combat conditions, they can fly at ultra-low altitudes – from several tens of meters. They move quickly, with visual hovering possible when flying in the observer's plane, up to tens of minutes, and short-term hovering when flying against the wind. Also, some types of UAVs with vertical take-off and landing can hover for a few minutes. Landing for small UAVs is possible on unprepared land. Visible through thermal imagers, especially well with jet and internal combustion engines	depending on the conditions of observation and the type of UAV. They are visible on radar
Residual effects, traces	Inversion trails from UAVs with jet engines can remain in the sky for a considerable time drifting in the wind	

Figure A.2.39 – Main aircraft-shaped UAVs used by russia and by Ukraine

Figure A.2.40 – Main aircraft-type UAVs used by russia and Ukraine. Lancet UAV; UAV Shahed-136 (Heran-2)

Table A.2.21 – Copter-type UAVs, swarms of drones, drops from drones

Parameter/ feature	Description	Note
Observation conditions	The probability of observation is lower in unfavorable weather conditions – wind, rain, drizzle	Flights of civilian UAVs are prohibited in Ukraine during martial law
Appearance, main visual features	They move quickly and can hover for up to several tens of minutes. Swarm drones look like a group or cloud of single objects, which can also create the appearance of a single object. They can have their own glow of a wide range of colors and variability. The outline is clearly defined. The color is varied.	The specific sound of a UAV can be heard at a great distance. Usually not visible on radar

Parameter/ feature	Description	Note
	Flight height is from several meters to several kilometers. Speed is up to 300 km/h. They are visible through a thermal imager. Drops look like objects separating from the carrier and falling vertically (and usually then explodes). The presence of a carrier is required	
Residual effects, traces	Absent	

Figure A.2.41 – Quadcopter; multicopter dropping a mine

Figure A.2.42 – Closelook and silhouette of the axial copter

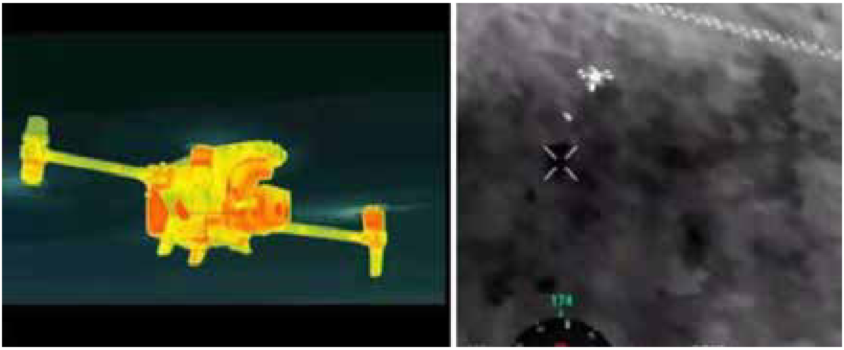


Figure A.2.43. – Thermographic images of a copter-type UAV

Figure A.2.44 – Formation of luminous spatial shapes by swarms of drones

Table A.2.22 – Lasers, holograms, spotlights

Parameter/ feature	Description	Note
Observation conditions	In cloudless weather, laser beams and spotlights are visible. Low cloud cover and fog are used for projecting images and holograms	
Appearance, main visual features	Color is same along the beam. There can be multicolored images holograms. The source is usually stationary or inactive, located on the ground. The outline can be clearly defined. The speed of movement is high, equal to the speed of movement of the of the ray. Possible inertial rotation, disappearance and appearance due to switching the source off/on. Visual altitude is the lowest level of cloud cover. Angular dimensions can reach several degrees	Sources can be compact portable, stationary or mobile on equipment, buildings, etc. There are no sounds. Not visible on radar
Residual effects, traces	None. As a rule, the location of the source can be traced by the rays	

Figure A.2.45 – Parallel beams of air defense searchlights; illumination of three searchlights in a low cloud cover

Figure A.2.46 – Laser projections on clouds; holograms

Figure A.2.47 – Floodlight beams from a single source;
light spot from a floodlight in low cloud cover

Figure A.2.48 – Reflection of city lights in low cloudiness; reflection of architectural lighting in a building

Figure A.2.49 – The illumination of two searchlights in low clouds; beams for detection of UAVs

Table A.2.23 – Inversion and convective dust trails

Parameter/ feature	Description	Note
Observation conditions	Separated from artificial civil and military aircraft	The source device may not be visible.
Appearance, main visual features	Both the formation of smoke plumes and already formed traces can be observed, which can be in the form of horizontal single and multiple stripes, circles, and vortices.	The sounds on considerable distance are not audible. Only the apparatus itself

Parameter/ feature	Description	Note
	The outline is blurred. The color may vary, including iridescent, depending on the conditions of observation. UAV with a thermite can have a spark that looks like a torch or a vertical column of fire. Termites are clearly visible in a thermal imager and have a high combustion temperature	can be seen on the radar when smoke is generated
Residual effects, traces	Inversion traces can last for several hours, slowly dissolving in the air and being blown away windward	

Figure A.2.50 – Sun illumination of an aircraft inversion trail; iris of the inversion trail

Figure A.2.51 – Plumes of substances sprayed from aircraft and from from UAVs

Figure A.2.52 – Fire suppression from a balloon; condensation around the wings of an aircraft

Figure A.2.53 – Strike UAV with a termite

Figure A.2.54 – UAV flamethrower in operation

Table A.2.24 – Solitons, colored clouds

Parameter/ feature	Description	Note
Observation conditions	They are observed in the case of man-made explosions and accidents; best seen during daylight hours, with satisfactory atmospheric visibility	
Appearance, main visual features	Pillars, rounded or mushroom-shaped clouds of smoke of different colors depending on the source, rising from the ground. The outline is blurred. Can be irregular. Altitude is below the cloud level. Solitons look like rings that always move up and downwind. Visual hovering is possible for up to several seconds. The diameter can reach several tens or even hundreds of meters. Colored clouds can not be visible in a thermal imager if the process is not thermal (like solitons). There are no light effects	There are no sounds, the formation can be preceded by explosions. Not visible on radar
Residual effects, traces	Solitons are fleeting phenomena without traces. Colored smoke can stay in the air for a long time and is carried away by the wind. Residual effects may include stains, discoloration, and environmental damage	

Figure A.2.55 – Solitons of anthropogenic origin from explosions or emissions

Figure A.2.56 – Colored clouds from chemical pollution

Table A.2.25 – Smoke, smoke screens

Parameter/ feature	Description	Note
Observation conditions	They are used in training exercises and combat missions for camouflage. They are usually observed during daylight hours, with satisfactory atmospheric visibility	They can be used manually, as charges on ground, water and air. They can be generated from special installations
Appearance, main visual features	Smoke-forming charges are fired from weapons with a sharply increasing smoke trail. When smoke screens are generated by installations, they look like clouds and streaks of smoke that are rapidly spreading and approaching. The outline is blurred. The shape can be varied, in the form of a dense opaque front. Colors are in shades of white. In the case of charges, the grenade/projectile cannot be visible. The angle of observation to the horizon is low. Dimensions can extend for several kilometers. There are no light effects. Visible through a thermal imager	Sounds are absent, formation can precede by sounds of explosions. The operation of the smoke production units is only audible in the close distance. Not visible on the radar

Parameter/ feature	Description	Note
Residual effects, traces	Smoke can remain in the air for a long time and is carried away by the wind. Residual traces may be present in spent charges at the site of use	

Figure A.2.57 – Ground smoke screens

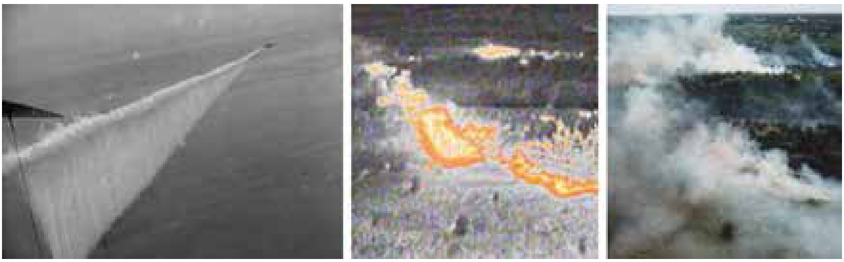


Figure A.2.58 – Smoke screens produced by an aircraft over the sea; thermal image and photo of the ground smoke screens

Table A.2.26 – Near ground explosions due to missile/UAV attacks, bombing and shelling

Parameter/ feature	Description	Note
Observation conditions	Smoke is more visible near the surface during the day, and a burst of explosion is more visible at night. During the war, missile and UAV strikes can be observed throughout Ukraine. Bomb and shell strikes can be observed in the frontlie and adjacent areas	The UAV cannot be visible before the explosion due to the high speed
Appearance, main visual features	It is characterized by sharp flash, usually in the white to orange spectrum and by delayed sound heard from a distance. Smoke cloud and dust remains mostly in the form of a ball or mushroom. Visible through the thermal imager	Single or multiple explosions are heard at a considerable distance. Not visible on radar
Residual effects, traces	Smoke clouds from explosions can stay near the ground for a long time and are carried away by the wind. In the area of explosions, the residual traces are craters, destruction, debris, and burning. Metal parts, large fragments, even the entire units can be found in places of falls due to malfunctions or crashes	

Figure A.2.59 – Rise of a fireballs from a mid-air explosions; thermal image of UAV explosion

Table A.2.27 – Tracer bullets and shells

Parameter/ feature	Description	Note
Observation conditions	They are observed in the combat zone, during training, exercises and during air defense operations. Better visible in the dark	
Appearance, main visual features	Small objects that glow or leave a distinct light trail. The color can be varied. Speed is very high; observation time is short. They can ricochet and spark when hitting other objects. Unidirectional straight or aeroballistics trajectories converge to one or more sources. Turns and trajectory changes are not possible. Observation angle above the horizon is different. The configuration is different, but not structured. Visible through a thermal imager, have a high combustion temperature	You may hear the sound of gunfire. Projectiles can be detected using special counter-battery radars
Residual effects, traces	Smoke trails can remain in the air	

Figure A.2.60 – Tracer bullets; shells (long exposure photo)

Table A.2.28 – Air explosion, burning of objects during falling

Parameter/ feature	Description	Note
Observation conditions	It is observed in the combat zone, during training and exercises	
Appearance, main visual features	Explosions are quick phenomena, they can be multiple, of random configuration. Falling objects are characterized by a sudden appearance in the air with fire or ignition of an already observed object; when falling, they can look like a fireball, its size is several times larger than the size of the object itself (aircraft, missile, UAV, etc.). Combustion products may break up into separate parts during the fall. The debrees trajectory can follow the trajectory of the object, with a gradual decrease or be vertical downward, like the fall of a tree leaf (for planar objects), or spiral. The height is below the cloud level. The fall velocity is subsonic. Burning objects are clearly visible in the thermal imager when falling due to their high temperature	You can hear the sounds of explosion during the fall. Explosions are not visible on radar, but the falling objects can be visible
Residual effects, traces	Traces of smoke from air explosions and combustion can last for several hours and are carried away by the wind. In and around the crash zone, residual traces include remains, object parts, combustion products, craters from possible explosions, liquid stains and individual elements	

Figure A.2.61 – Missile air explosion; burning of a russian aircraft in the crash

Figure A.2.62 – Multiple explosions of anti-aircraft shells; missile impact in the upper atmosphere

Table A.2.29 – Heat traps released from aircrafts

Parameter/ feature	Description	Note
Observation conditions	Heat traps separated from military aircraft during training or combat missions. They can also be installed on UAVs and missiles	The launch of object cannot be visible as a result of rapid span, during observation
Appearance, main visual features	Heat traps are shot as brightly burning objects with a smoke trail. The outline is blurred. The trajectory is parabolic to the ground. Speed is 30-50 m/s. No hovering is possible. Can be seen clearly in the thermal imager, have high combustion temperature	The sounds of firing and burning can be heard only from a short distance. Almost invisible on radar
Residual effects, traces	Smoke plumes can last for several hours and are carried away by the wind. Burnt remains can be found on the ground	Localized fires and ignitions can occur at low launch heights, in the place of hits thermal traps into the ground

Figure A.2.63 – Heat traps released from helicopter and from aircraft

Table A.2.30 – The Prandtl-Gloert effect

Parameter/ feature	Description	Note
Observation conditions	It is observed on aircraft, missiles and other supersonic aircraft during travelling at subsonic speeds.	The cone is observed in a narrow range of speed
Appearance, main visual features	A cone- or lenticular cloud condensate is arising around the aircraft. It condenses from the air, dissolves in it. The speed is equal to the speed of the aircraft, moving with it. The diameter, as a rule, does not exceed 2 aircraft lengths. The outline is blurred, hazy, but from a distance it can appear to be outlined. The thermal imager can see the object itself, which is associated with the effect.	The front part of the apparatus is visible from the condensation cloud. No sounds are heard. It is not seen by the radar
Residual effects, traces	Absent	

Figure A.2.64 – Prandtl-Gloert effect around aircraft

Figure A.2.65 – Prandtl-Gloert effect around aircraft

Table A.2.31 – Triboluminescence

Parameter/ feature	Description	Note
Observation conditions	It is observed on artificial aircraft with moving rotating parts – helicopters, planes etc., in the presence of a significant amount of suspended dust, sand, etc. in the air. Observation is possible only at night or in low light conditions.	The phenomenon is typical mainly for southern regions with sandy and dust storms.
Appearance, main visual features	The propeller sparkles due to friction and this glow from a distance forms a circle or several circles (according to the number of propellers) that move with the aircraft. You can see the aircraft, its body, and/or its onboard lights. There may be groups of objects. The outline is blurred. The color is from white to orange. Hover time and other motion characteristics are specific to the source. The object itself can be seen through the thermal imager.	The sound of screws can be heard from a considerable distance. The radar shows the carrier.
Residual effects, traces	Absent	

Figure A.2.66 – Triboluminescence around helicopter propellers

Table A.2.32 – Artificial fires, bonfires

Parameter/ feature	Description	Note
Observation conditions	It is a ground phenomenon that can appear as low-hanging objects in changing terrain at night	These are artificial sources of fires, arsons, consequences of war, etc.
Appearance, main visual features	It is a bright burning of variable shape and brightness, warm colors, from a distance can appear as a pulsating light object. Burning can last for several hours or even days. Burning of chemical materials and artificial objects can have different colors depending on their composition. The outline is blurred. There is no movement, but there can be polymorphism. The angle of observation above the horizon is low. Clearly visible in the thermal imager	Zoom allows you to identify a fire even from a considerable distance. Burning sounds are only audible from a short distance. Not visible on radar
Residual effects, traces	Smoke can remain for many days due to smoldering, there are many signs of fire at the site	

Figure A.2.67 – Observation of an offshore drilling platform fire on the horizon (Odesa city, Ukraine); a fire started in the mountains

Table A.2.33 – Glare from man-made objects

Parameter/ feature	Description	Note
Observation conditions	It is a natural or artificial light source directed counter to the reflector.	
Appearance, main visual features	Glare, reflected from man-made objects, looks like a bright object or several objects that can disappear and appear suddenly (the movement corresponds to the source) when the object with the reflector moves, due to changes in angles. The observation time can be considerable. Dimensions are up to several meters. The angle of observation above the horizon is low. It is not visible in the thermal imager, but the object can be detected – the source of the reflection.	Glare can be produced by many anthropogenic technical objects that have shiny surfaces or glass elements (aircraft, weather probes etc.), then the movement of the glare has the properties of the object. There are no sounds heard. No sign of the object on the radar.
Residual effects, traces	None. Stationary objects can be identified when approaching them	

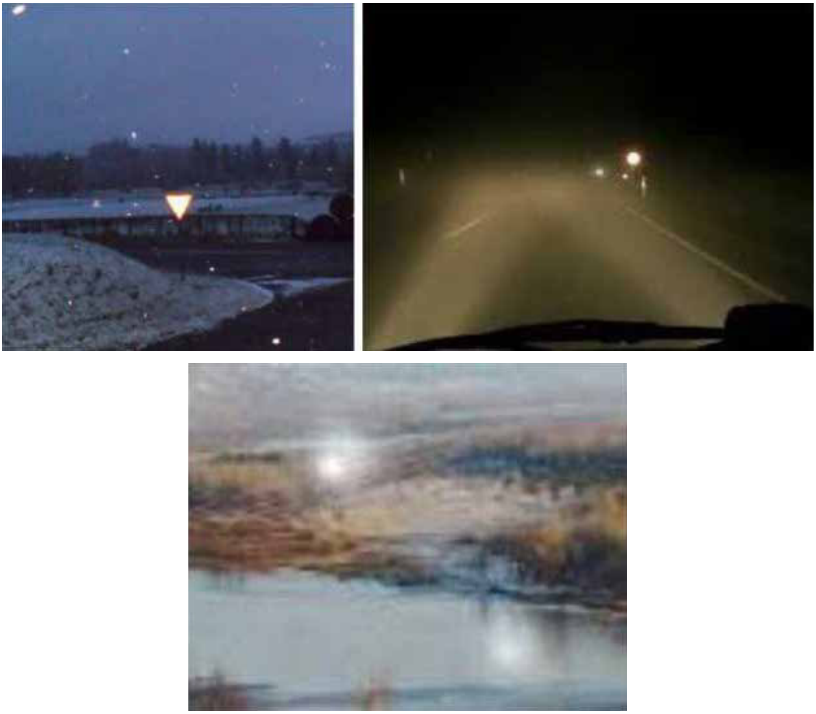


Figure A.2.68 – The glare of a road sign from a flash; the glare of the headlights of a car headlights; glare of a glass object in the forest from the sun

Annex 3

QUESTIONNAIRE FOR REGISTERING THE OBSERVATION OF AN UNIDENTIFIED OBJECT/PHENOMENON

Purpose: The questionnaire is filled out to document the observation of an object/phenomenon that cannot be identified as natural or anthropogenic during the initial analysis, as well as to maintain general records and reporting on unidentified aerospace objects/phenomena.

Terms of use: these questionnaires are intended for in-depth analysis with the aim of definitive identification of the observed unidentified aerospace object/phenomenon. The questionnaire data is confidential, unless otherwise indicated by the submitter. Contacts are provided for possible feedback and to clarify the data. The questionnaire is intended to be filled in by persons who have witnessed unidentified aerospace objects/phenomena. Only testimonies from direct eyewitnesses of unidentified aerospace objects/phenomena or persons who recorded them remotely using technical devices and means are accepted.

How to fill in the questionnaire: fill in the questionnaire as completely as possible in printed letters in electronic form or by hand. If there is no data on any of the questions, a dash should be placed in the corresponding item. If there is not enough space for a detailed answer, additional data can be provided on separate sheets attached to the questionnaire or on its reverse side. In the text of the questionnaire, indicate the number of the item to be supplemented. If necessary, the entire story, as complete as possible, as well as illustrative and supplementary material to it, can be submitted separately in files or on sheets.

1. **Data on the person who observed the unidentified aerospace object/phenomenon (if there are several persons, several questionnaires are filled in)**

Surname ____________________

Name ____________________

Date, month, year of birth ____________________

Education, specialty ____________________

Type of activity (place of work/employment), title ____________________

Postal address ____
Mobile phone ____
E-mail ____
Were there other witnesses who observed the object
or phenomenon? (Yes/No) ______________________________
If yes, please indicate how to contact them ____________________

2. General information about the circumstances of the observation

Date, time of day of observation ____________________________
Observation location, coordinates ___________________________
Where you were exactly at the time of the observation? ______________
If you moved during the observation or used a moving UAV,
please indicate the approximate speed of movement, direction
and whether you stopped etc. ______________________________
Specify the weather conditions at the time of observation:

Cloud cover	Clear skies		Light clouds		Cloudy		Darkness	
Temperature	Cold		Cool		Heat		It's hot	
Wind	Calm		Light breeze		Moderate		Strong	
Precipitation	Dry		Fog		Tos		Snow	
State of the sky	Stars.		Month		Planets		Sun	

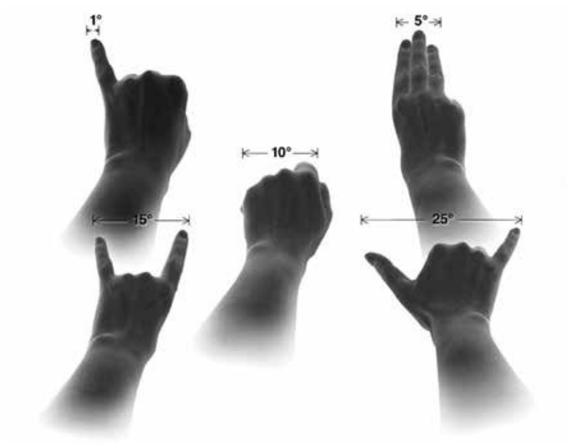
If you have accurate meteorological data at the time of observation (temperature, pressure, humidity, wind speed and direction), type of clouds, please provide these data separately ______________________
Describe the visibility at the place of observation
(indicate what limited the view or if you were indoors) ______________
If technical devices and means were used for observation, indicate their types, models and main characteristics, modes in which the unidentified aerospace object/phenomenon was recorded, and features of the recording ______________________________

3. Characteristics of the observed unidentified aerospace object/phenomenon

3.1. General characteristics of an unidentified aerospace object/phenomenon

Start time of observation _________________________________

Did you see the moment of appearance of the object or phenomenon? ________
Observation end time ________
Did you see the object or phenomenon disappear? (Yes/No) ________
Outline of the object or phenomenon (illustrations/photos/video to be attached separately) ________
Form of the object or phenomenon (illustrations/photos/video to be attached separately) ________
Was there a change in shape of the object or phenomenon? (Yes/No) ________
Color (illustrations/photos/video to be attached separately) ________
Have you observed any color changes? (Yes/No) ________
Linear dimensions of the object or phenomenon (diameter and individual elements, if available/known)
Angular dimensions of the object or phenomenon ________



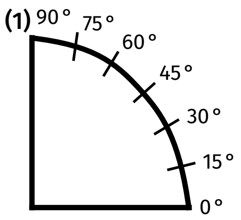
Scheme for simply determining the corner dimensions of the object or phenomenon

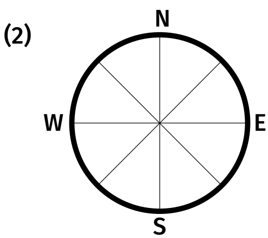
If you put your arm outstretched towards the localized object or phenomenon, what was the apparent size, corresponding to the dimensions in the illustration above, or if its size is compared to the size of a familiar object? The angular size of the object/phenomenon can also be given in comparison to the Moon or other objects in the sky with known size and location.

Lighting effects of the object or phenomenon or its parts ____________________
Brightness of the object or phenomenon or its ____________________
Thermographic image (if available, attach photo/video separately) ____________
Sounds from the object or phenomenon____________________
Were there any smells from the object or phenomenon?____________________
Other details and more____________________

3.2. Characteristics of the location of an unidentified aerospace object/phenomenon in space

Number of object or phenomenon____________________
Configuration of object or phenomenon (if they are not single) ____________
Height of the object or phenomenon____________________
Angle to the horizon____________________
Direction of observation____________________
Crossing the clouds____________________
Location relative to objects you know ____________________





Auxiliary diagrams for determining the angle to the horizon and the direction of movement of an object or phenomenon by the cardinal points

3.3. Motion characteristics of an unidentified aerospace object/phenomenon Maximum hover time Direction of movement

Trajectory____________________
Linear velocity____________________
Angular velocity____________________
Changes in the speed of movement of the object/phenomenon (if observed) ___
Acceleration ____________________
Turning radius____________________
Angular turning velocity____________________

4. Physical actions

Was there any interaction between the object or phenomenon and the earth's surface? ______

If you notice any residual effects, traces, material evidence after the disappearance of the object or phenomenon, describe it ______

If you notice any unusual effects in the behavior of people, animals, devices, etc., describe them ______

Are there any traces of the impact of the object or phenomenon on your body? ______

What was the threat assessment? ______

Were there any your attempts to get closer to the object or phenomenon? ______

Were there any your attempts to damage the object or phenomenon? ______

If there are corroborating photos, videos or other material evidence, they should be attached separately, in the original.

5. An eyewitness point of view

Your psychological state at the beginning of the observation ______

How did you notice the presence of the object or phenomenon? ______

What exactly did you do at the beginning of your observation? ______

What exactly made you stop watching?______

Have you shown interest in similar phenomena before? If so, what kind and how strong was it? ______

Did your opinion change after the observation? If so, please state it changes ______

Who was the first person you told or reported the sighting to? What was the reaction to your story? ______

What is your personal opinion about the observed object or phenomenon? What exactly could it be? ______

By filling in this form, do you want your personal data to be confidential or public? ______

Date of completion ______

Signature ______

The completed questionnaire should be sent to srcaa@zond.kiev.ua for processing and analysis