bellingcat

MH17

The Open Source Investigation
Two Years Later

by and for citizen investigative journalists

Introduction

At 4:20pm local time on July 17, 2014, Malaysian Airlines Flight 17 (MH17) was shot from the sky over eastern Ukraine, killing all 298 passengers and crew members. Within hours, the world became aware of the general circumstances that led to the tragedy: a group of pro-Russian separatists shot down the passenger plane with a Buk anti-aircraft missile. Two years later, we know that these facts still hold up. However, largely due to a wealth of openly accessible and verifiable information, these two years have also given us a tremendous amount of evidence confirming this general set of circumstances, including the identity of the weapon that was used to shoot down MH17 and the Russian anti-aircraft missile brigade that supplied this weapon.

This report will serve as a survey of the information related to the downing of MH17 that is freely available for anyone with an internet connection to access, analyze, and verify, also known as open source information. This information can be found anywhere from a newspaper to the social media account of a Russian or Ukrainian serviceman. What this report will not provide is information obtained through confidential or "closed" sources, such as non-public intelligence reports or secret interviews with witnesses or human sources. With an event as controversial and significant as the downing of MH17, it is vital that, to the greatest extent possible, information tied to the case is accessible by the public, and verifiable.

Furthermore, in this report we have sought the opinions and assessments of subject matter experts regarding our analyses of open source information. Their analyses are presented throughout this report, providing an additional analytic perspective to the open source evidence.

Situation in the Donetsk Oblast, July 2014

The course of the war in eastern Ukraine turned on July 1 after a week-long ceasefire, with a renewed offensive from Ukrainian Forces. Most significantly, Ukraine retook the city of Sloviansk on July 5, which was previously seized by the infamous separatist commander Igor "Strelkov" Girkin. Many of the forces of the Donetsk People's Republic (DNR) retreated to Donetsk after fleeing Sloviansk, Kramatorsk, and other cities in the northern part of the oblast. In anticipation of a Ukrainian offensive into the separatist stronghold, separatist forces destroyed numerous bridges and blocked a series of strategic roads leading into Donetsk.

On July 14, 2014, soldiers of the Russian Federation launched a devastating artillery attack against Ukrainian army positions near Amvrosiivka,[1] Ukraine. This attack, which can be observed in at least 330 craters visible on Google Earth imagery from July 16, 2014, was launched from a position inside Russia near the Russian village of Seleznev, approximately 750 meters from the Russia-Ukraine border. Two days later, on July 16, numerous videos surfaced of 122mm BM-21 Grad systems launching artillery attacks westward, towards Ukraine, from the Russian city of Gukovo. For the first time, the Russian military was launching direct artillery attacks from their own territory, with their own equipment, and with their own soldiers, against the Ukrainian military.

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[1] https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/

With the gains of the Ukrainian ground forces and counter-attack of Russian artillery systems, Russia and the separatist forces of the Donetsk People's Republic also needed to deal with the Ukrainian air offensives in separatist-held territory. On July 15, a Ukrainian warplane hit a residential building in Snizhne, killing eleven civilians and injuring another eight.[2] Ukraine blamed Russia for this attack,[3] but there is no evidence lending credence to this accusation. The Ukrainian military carried out numerous other attacks in the week before the downing of MH17 in both the Donetsk and Luhansk Oblasts, but separatists also made numerous successful attacks against military jets and transporters.

On July 14, a Ukrainian AN-26 transport plane was shot down near the Russia-Ukraine border in Izvaryne.[4] The exact cause of this shoot down is not entirely clear, and some parties claimed it was flying beyond the range of shoulder launched Man Portable Air Defence Systems (MANPADS) known to be in possession of separatist forces, implying it was shot down by a larger air defence system. On July 16, a Ukrainian Su-25 ground attack jet was shot down in the Donetsk Oblast, while another was damaged, but not destroyed.[5] Video footage from July 16 near Stepanivka, just a few kilometers from the eventual launch site of the missile that downed MH17, shows separatist leaders Aleksandr Borodai and Igor Girkin next to a Strela-10 anti-aircraft system.[6]

Clearly, a concerted effort was being made to control the skies in the Donetsk Oblast, with the presence and likely use of a Strela-10 system along with MANPADS. With the escalation of Russian involvement with direct artillery strikes and the prioritized effort to neutralize Ukrainian air power, Russia's decision to provide a powerful Buk-M1 anti-aircraft missile system to separatist forces is entirely logical.

Figure 1: Twitter post reporting the sighting of an anti-aircraft missile system in Donetsk

Further reading:

- *The Guardian*: Russia shelled Ukrainians from within its own territory, says study
- IPHR: New report documents cross-border attacks in eastern Ukraine
- Bellingcat: Origin of Artillery Attacks on Ukrainian Military Positions in Eastern Ukraine Between 14 July and 8 August 2014

2 http://www.bbc.co.uk/news/world-europe-28309034
3 http://www.reuters.com/article/us-ukraine-crisis-idUSKBN0FJ0R720140715
4 http://www.bbc.co.uk/news/world-europe-28299334
5 http://www.bbc.co.uk/news/world-europe-28345039
6 https://www.facebook.com/bellingcat/posts/504820833039706

Tracking the Buk on July 17

For six hours before the downing of MH17, Ukrainians publicly discussed a Buk missile launcher slowly creeping through eastern Ukraine, before it was eventually filmed heading south out of the town of Snizhne, towards the center of the location where the Dutch Safety Board (DSB) would calculate a missile launch occurred.[7]

An example of these messages can be seen below, from the Twitter account @666_mancer. In the message below, the visible time -- circled in red -- is set for the local time zone (GMT +3). In the message,[8] the user says that thirty minutes ago (thus, around 9:40am), some sort of anti-aircraft system, possibly a Strela-10, was seen near Prospekt Ilicha in Donetsk.

More detailed and reliable witness accounts continued to appear throughout the day.

At 10:40am local time, a public group called "Donetsk is Ukraine!" in the Russian-language social network VKontakte (VK) posted a more detailed witness account:[9]

Bad news. Around 9am, a hauler was going along the Makiivka highway[10] from Makiivka in the direction of Donetsk. On the platform was a BukM1-M2? This AAMS[11] proceeded to the intersection with Shakhtostroiteley Boulevard[12]. The system was accompanied by a convoy that was composed of 1 grey Rav4 SUV, a camouflaged UAZ, and a dark blue Hyundai van with tinted windows. As of 9:15am, the vehicle was located at the intersection of Shakhtostroiteley and Ilycha. The militants got out of their cars, blocking 2 of the far left lanes. Obviously, they were waiting for logistical guidance.

Figure 2: The first Paris Match photograph from Donetsk

Figure 3: The second Paris Match photograph from Donetsk

7 https://www.bellingcat.com/news/uk-and-europe/2015/10/17/dsb-launch-site/
8 https://twitter.com/666_mancer/status/489668680398438400
9 https://vk.com/wall-67445695_68330
10 https://goo.gl/EMHpuD
11 https://en.wikipedia.org/wiki/Surface-to-air_missile
12 https://www.google.com/maps/@48.0023894,37.8554593,881m/data=!3m1!1e3

The French tabloid magazine *Paris Match* has shared two images[13] [14] showing the Buk in Donetsk. In the first image, a gray 2010 Toyota RAV4—matching the witness account from the "Donetsk is Ukraine!" VK group—is seen ahead of a Volvo truck hauling a Buk-M1 TELAR (Transporter Erector Launcher and Radar). In the second image, various details of the Buk missile launcher are clearer, including the netting above the four mounted missiles.

The exact time that these images were captured is unclear, but were certainly taken between 9:30am and 11:00am. Paris Match stated that the photograph was taken "about 11am" on the morning of July 17th.[15] There is far less uncertainty about the location of the images. The visible landmarks in the photograph reveal the exact location of the Volvo truck and Buk as near the Motel roundabout in eastern Donetsk.

Figure 4: Frame from the video of the Buk missile launcher transported through Makiivka

On May 3, 2016 a video was posted online showing the same Volvo truck transporting the Buk missile launcher in Makiivka, east of the previous sighting in Donetsk.[16]

On June 22, 2016, Google published satellite imagery from Digital Globe of the area captured on July 17th 2014, showing the truck moving through Makiivka close to the location shown in the video.[17] Based on information from Digital Globe, the satellite image was captured at 11:08am local time.

Notably, in addition to the truck and Buk, the Makiivka video also features other vehicles that appear to be in convoy with the truck, including a grey Rav4 SUV and a camouflaged UAZ, as described in the 10:40am post in the "Donetsk is Ukraine!" group. In addition to those vehicles, a black or dark blue Volkswagen van was also present, and all three vehicles featured in a video of another separatist convoy, this time transporting military equipment to Donetsk from Luhansk, filmed on July 15th.[18]

13 http://www.parismatch.com/Actu/International/EXCLU-MATCH-Un-camion-vole-pour-transporter-le-systeme-lance-missiles-577289
14 https://www.bellingcat.com/news/uk-and-europe/2015/01/17/new-images-of-the-mh17-buk-missile-launcher-in-ukraine-and-russia/
15 https://plus.google.com/+IainMartin/posts/MWyx9pgG4tNQ
16 https://www.bellingcat.com/news/2016/05/12/9248/
17 https://www.bellingcat.com/news/uk-and-europe/2016/06/22/new-google-earth-satellite-update-confirms-presence-of-buk-in-eastern-ukraine/
18 https://www.bellingcat.com/news/uk-and-europe/2016/03/04/8110/

Figure 5: Positions of vehicles in the Makiivka video from satellite imagery dated July 17 2014 (Source - Google Earth/Digital Globe)

Figure 6: Comparison of vehicles in July 15 and 17 convoys

Figure 7: Twitter post containing the Zuhres Buk video

The next confirmed sighting of the Buk was in the town of Zuhres, located approximately 25 kilometers east of the location in Makiivka where the missile launcher was previously seen.[19] The Buk was filmed traveling east on H21,[20] a highway running from Donetsk, through Makiivka, Khartsyz'k, and eventually to Torez and Snizhne. A Twitter user named @3Andryu created a YouTube account, uploaded a video of the Buk passing by, and tweeted a link of the video. This user, who later deleted his Twitter account, often publicly shared[21] the movements of separatist armour through Zuhres. Thus, he is likely a resident of Zuhres and almost certainly filmed the video himself or acquired it from another resident and posted it. The user included the exact coordinates and time of the video, with the location being confirmed as correct by numerous journalists, including teams from ARD TV,[22] Correctiv,[23] and 60 Minutes Australia.[24]

As the Buk moved eastward, it crossed into more heavily populated areas, thus significantly increasing public chatter and the number of witness accounts. The witness accounts alone do not confirm the Buk's presence, but these reports do provide an extra layer of evidence to the photographs, satellite images, and videos of the Buk's presence in eastern Ukraine on the day of the downing.

With the Ukrainian conflict came the seemingly new phenomenon of pro-Ukrainian Twitter users who share information received from occupied areas of eastern Ukraine. Richard Pendry, Lecturer in Broadcast Journalism at the University of Kent, recently travelled to Ukraine to study this phenomenon. He weighs in on the reliability of these sources and the nature of this type of information warfare.

19 https://www.bellingcat.com/news/uk-and-europe/2014/07/28/two-more-key-sightings-of-the-mh17-buk-missile-launcher/
20 https://www.youtube.com/watch?v=LO4a3T4t7iw
21 https://archive.is/dZhrQ
22 http://www1.wdr.de/mediathek/video/sendungen/die_story/videotodesflugmhwarummusstenmenschensterben100.html
23 https://mh17.correctiv.org/english/
24 http://www.9jumpin.com.au/show/60minutes/stories/2015/may/mh17/

Richard Pendry, portrait courtesy of Kent University's website

In September 2015 I went to Ukraine to find some of the sources behind the Twitter handles and other pseudonyms figuring in Bellingcat investigations, including MH17. I wanted to understand who these people are and what motivates them. After speaking to a number of sources I would say they can be classified into the following categories, whose membership somewhat overlaps:

1. Civilians with friends and family who are trapped inside the occupied areas, that provide practical information to keep their friends and loved ones safe.

2. Patriotic individuals who have set up online propaganda ventures on their own initiative to expose what they see as Russian wrongdoing.

3. Individuals who are hoping to promote themselves as patriots while advancing their own political and financial advantage. (In one case, a blogger-politician confessed he used his large Facebook following to pressure the state to fund a defence contract; in another, a source turned out to be seeking funding for a military operation.)

4. Individuals who want to help the military and security agencies target Russian and separatist forces

All the people I met work as what might be termed 'local aggregators'. It is dangerous to live-tweet sensitive information directly from the battlefield, and no one I met did this. So while the aggregators' Twitter profiles may be linked to battlefield locations, as a rule they are not located where they say they are.

It's unreasonable to expect people from a war zone to be impartial about events there — and they aren't. These patriotic and deeply involved individuals gather, process, and deliver information to news audiences in an extremely chaotic and decentralised fashion. This is utterly unlike the well-organised Russian propaganda operation.

To sum up: the Bellingcat sources have very mixed agendas. It is understandable that these people act out of complex motives. While we cannot change this, it is important for the wider audience that anyone dealing with them be as transparent as possible in order to evaluate the quality of the information presented. Often the transparency is missing and outsiders can make mistakes with information from sources because the latter's agendas are not clear. That said, I found no evidence that any aspects of Bellingcat stories whose sources I studied are untrue.

The sightings of the Buk continued after it entered Torez. At 12:07pm,[25] @WowihaY passed on a message that he had received:

Figure 8: Tweet reporting a sighting of a Buk missile launcher in Torez on July 17 2014

A surface-to-air launcher just passed us in the direction of the city center. 4 rockets, people are saying that it's a Buk #stopterror #torez in the direction of #snizhne

A tweet from 12:26pm[26] reported almost the exact same scene, timed at 12:10pm in Torez. The same user later followed up with another tweet,[27] saying that the Buk was covered up top, mirroring the covering seen in the second Paris Match image from the morning in Donetsk and the video of the Buk in Makiivka.

Figure 9: Tweet reporting a sighting of a Buk missile launcher in Torez on July 17 2014

At 12:05pm I received a text "Birdies, beware!" from a person who was well-versed in weaponry. He suggested that they were transporting a "Buk" anti-aircraft missile system.[28]

They hauled a rocket complex on a low-loader escorted by two vehicles through Torez towards Snizhne at 12:10pm.

[25] https://twitter.com/WowihaY/status/489698009148837888
[26] https://twitter.com/MOR2537/status/489702736766586880
[27] https://twitter.com/MOR2537/status/489709431467171841
[28] https://www.bellingcat.com/resources/interviews/2015/07/27/interview-with-wowihay/

Like in Donetsk, the scene that was being described by local residents was also captured in an image. The photo appeared on VK, and though the original post disappeared, the image was saved and reposted frequently on July 17.

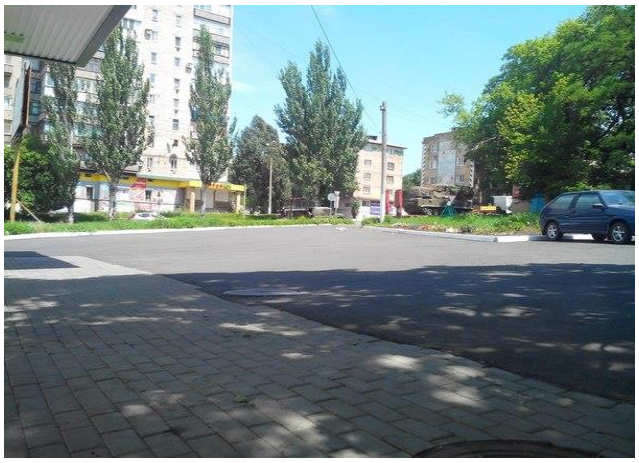


Figure 10: Photograph of a Buk missile launcher transported through Torez on July 17 2014

This photograph, located outside of the StroiDom hardware store in Torez, Ukraine, shows the same Buk missile launcher on the Volvo truck previously seen in the Paris Match images, Makiivka video, and Zuhres video.[29] As with the Zuhres video, the location was confirmed by journalists from ARD TV,[30] Correctiv,[31] and 60 Minutes Australia.[32] Additionally, journalists from the Guardian[33] and Buzzfeed[34] visited the location just days after the downing of MH17 and were able to confirm with locals that a Buk missile launcher traveled through this location just after noon on July 17.

"We were inside and heard a noise much louder than usual," said one shopkeeper, who did not want to be identified. "We came running out and saw a jeep disappearing into the distance with something much larger in front of it. Later, customers said it had been a missile carrier." In another shop further down the street, there was talk of a convoy of two jeeps and a missile launcher covered in a net driving past in the direction of the town of Snizhne. "I've never seen anything like it," said a middle-aged woman. She said her husband showed her a photograph of a Buk launcher afterwards and she realised that was indeed what she had seen. A group of men also said they had seen a Buk.

-Shaun Walker, *The Guardian*

29 https://www.bellingcat.com/news/uk-and-europe/2014/07/18/buk-transporter-filmed-heading-to-russia-sighted-in-an-earlier-photograph/

30 http://www1.wdr.de/mediathek/video/sendungen/die_story/videotodesflugmhwarummusstenmenschensterben100.html

31 https://mh17.correctiv.org/english/

32 http://www.9jumpin.com.au/show/60minutes/stories/2015/may/mh17/

33 http://www.theguardian.com/world/2014/jul/22/ukraine-sightings-missile-launcher-mh17

34 http://www.buzzfeed.com/maxseddon/locals-say-rebels-moved-missile-launcher-shortly-before-mala

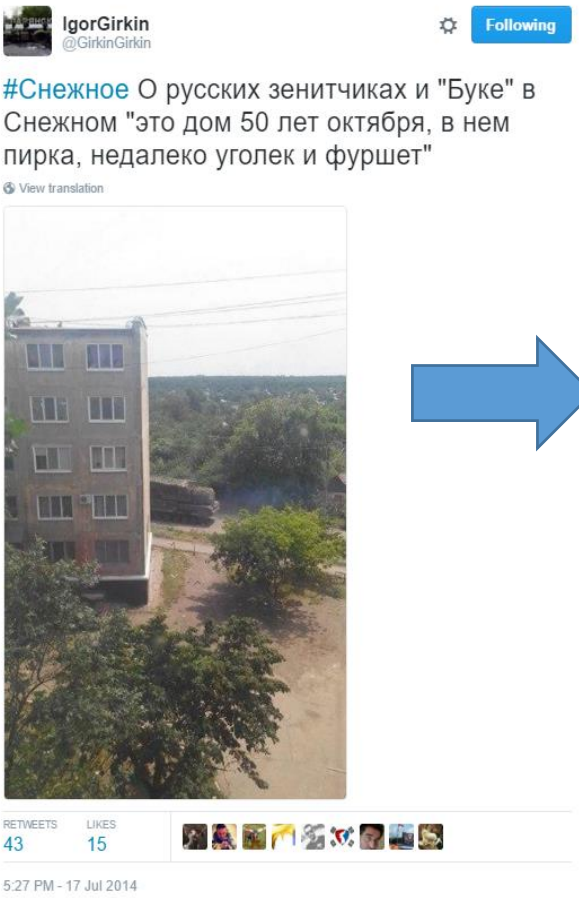
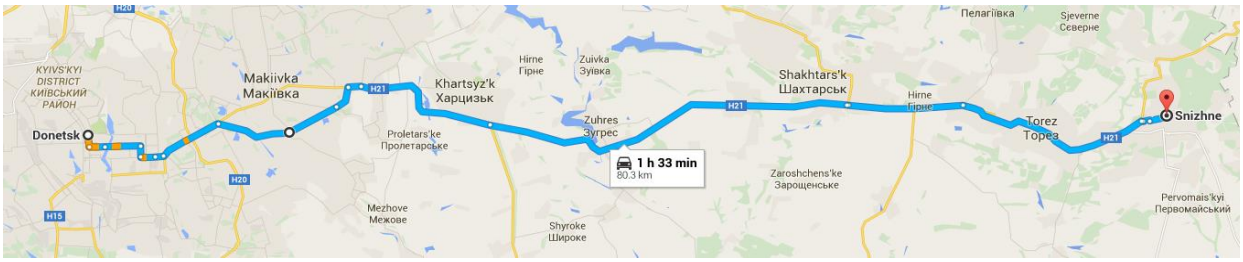


Figure 11 Photograph of a Buk missile launcher in Snizhne on July 17 2014

Another photograph appeared soon after, showing the Buk missile launcher – now moving under its own power and without the Volvo truck – headed eastward in Snizhne.

This photograph originally appeared on VK and was shared by the pro-Ukrainian user @GirkinGirkin. A video shot soon after this photograph shows the Buk missile launcher moving southward out of Snizhne towards its eventual launch location.[35]



[35] https://www.youtube.com/watch?v=iE7wEhvYFos

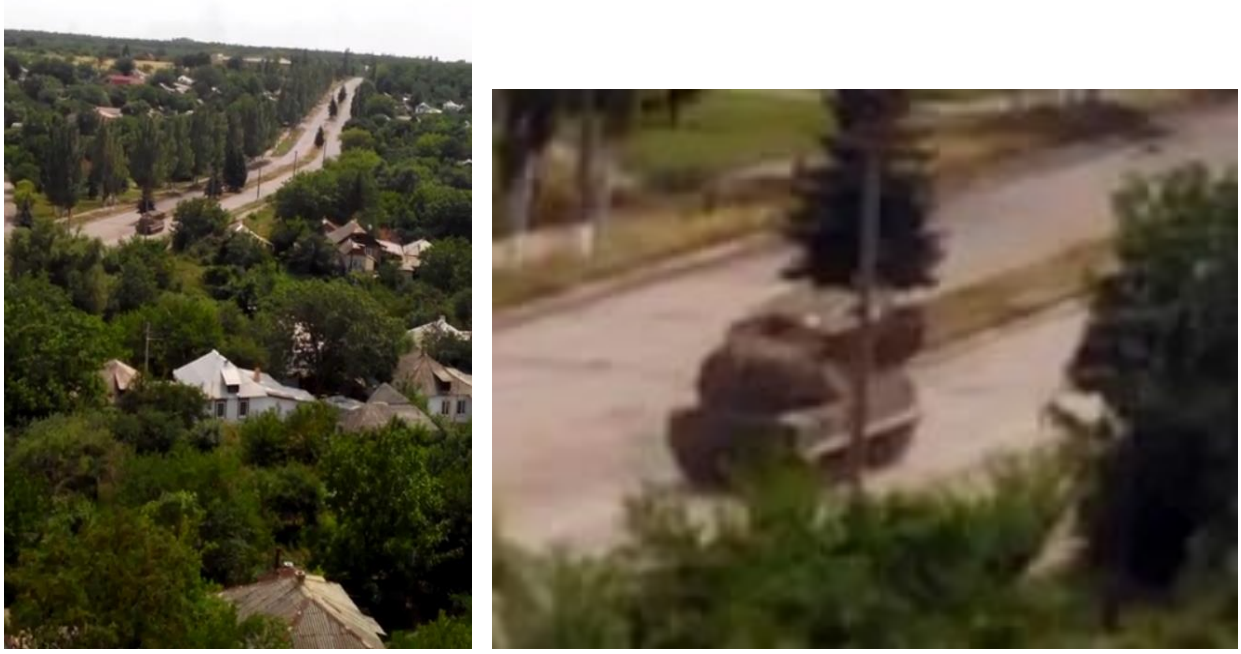


Figure 12: Frame and detail from the video of a Buk missile launcher heading out of Snizhne on July 17 2014

These images of the Buk in Snizhne are corroborated by reports of a journalist from the Associated Press, who was in Snizhne on the day of the tragedy.[36]

An Associated Press reporter on Thursday saw seven rebel-owned tanks parked at a gas station outside the eastern Ukrainian town of Snizhne. In the town, he also observed a Buk missile system, which can fire missiles up to an altitude of 22,000 meters (72,000 feet).

-Peter Leonard, Associated Press

Further reading:

- Bellingcat: MH17 In Their Own Words: Witness Testimonies on Social Media from July 17, 2014
- Bellingcat: Origin of the Separatists' Buk
- Bellingcat: Interview with "WowihaY," the Man Who Narrated MH17 as it Happened
- Bellingcat: Tracking the Vehicle that Transported the MH17 Buk
- Bellingcat: Possible new sighting of MH17 Buk Convoy on July 17th 2014 in Ukraine
- Bellingcat: New Google Earth Satellite Update Confirms Presence of Buk in Eastern Ukraine
- Bellingcat: Separatist Convoy Linked to MH17 Buk Transport
- *Correct!v*. Flight MH17: Searching for the Truth
- *Paris Match:* A stolen truck to transport the missiles
- *News.com.au*: MH17 breakthrough: owner of Volvo truck that transported missile fears for his life
- *BBC*: Who Shot Down MH17?
- *60 Minutes Australia*: MH17: A Special Investigation

[36] http://bigstory.ap.org/article/russia-dismisses-us-sanctions-bullying

The Missile Launch

Almost exactly three hours after the downing of MH17 the following photograph was posted on Twitter:

Figure 13: Original Twitter post showing the smoke photographed from Torez

The tweet from @WowihaY describes how a witness to the missile launch sent the photograph to him, showing the traces of a missile launch to the southeast of Torez. The metadata of the photograph showed that it was taken at 4:25pm (five minutes after the shootdown), according to the camera's internal clock, and 4:22pm through shadow analysis.[37]The blogger Ukraine@War (now Putin@War) was able to geolocate[38] the source of the missile trail in the photograph to a field just east of the village of Chervonyi Zhovten (Red October), and south of Snizhne. Bellingcat[39] conducted a similar investigation, coming to similar conclusions: the missile was fired from a field south of Snizhne.

Numerous witnesses have reported seeing or hearing a missile launch from south of Snizhne, further strengthening the evidence presented by this photograph. In the resulting confusion of the plane's downing, hundreds of messages popped up on VK, Twitter, and other social networks amongst witnesses of the events. Before the narratives of both the Russian/separatist and Ukrainian sides emerged, these raw reactions reveal unfiltered information about what had just occurred.

In one thread on VK, which began just 9 minutes after the shoot down[40], a witness says that "something buzzed above us, but not like a plane, people are saying that it was a rocket that went up to it." In another witness account,[41] a man describes what could only be a rocket launch immediately before the downing of MH17. As he describes, "I saw that something was flying. I was out in the country in a tree, picking pears. And then an explosion." Another Snizhne resident posted soon after the crash,[42] "I saw how this rocket flew! I even saw where it came from and where it went!" In an extended conversation, two women who support the pro-Russian separatists in their cities talked about what they had seen. In one revealing message, a local woman described:[43]

I saw how a rocket flew from the direction of Saurovka...and then a minute-long lull and a loud explosion...a trail remained in the sky from the rocket...I didn't see the explosion myself it was very loud...all of my family ran out into the street...we were all very scared.....I don't know who to believe but we didn't hear the sound of a SU[-25]....it was quiet just like with a normal passenger plane and then that's all....

Though many separatists said that a Ukrainian fighter jet was responsible for the downing of MH17, at least one separatist betrayed this narrative in a VK message to the "News of Snizhne" public group. Just 34 minutes[44] after the downing, he wrote "Don't write where they fired from if you don't want them to bomb us."

Witness accounts attesting to a rocket launch to the south of Snizhne, matching the photograph posted by @WowihaY, are not only found in postings on social networks. The

37 https://www.bellingcat.com/resources/case-studies/2015/08/07/shadow-of-a-doubt/
38 http://ukraineatwar.blogspot.nl/2014/07/launch-location-detected-of-missile.html
39 https://www.bellingcat.com/news/uk-and-europe/2015/01/27/is-this-the-launch-site-of-the-missile-that-shot-down-flight-mh17/
40 https://archive.is/atPAU
41 https://archive.is/3EYU5
42 http://archive.is/OpG5C
43 https://archive.is/4D6ZA
44 https://archive.is/yBgk3

group chat app Zello, popular in eastern Ukraine, gives dozens of instantaneous witness reactions to what had just happened after the Buk missile launch.[45] Zello recordings are easily archived and saved, allowing us to revisit these reactions from shared recordings. While many of these reactions do not contain useful information ("Guys a plane has crashed" ... "Have they caught the pilot?"), there are also unfiltered witness accounts that provide information regarding the missile launch. One witness reports seeing something near the KhimMash factory, located in the northern part of Snizhne: "something going upwards... like smoke, something like a smoke trail (...) as if some kind of a missile launch upwards." Another witness reports something flying "from Saurivka" located just south of the Buk missile launch location. This witness reports that this object, which she thought was "a missile," was "flying and smoking--with a white smoke--and had a strong buzzing loudly above Oktyabr' flying (...) towards the town."[46] Clearly, there are a wealth of witness reports from immediately after the plane crash to corroborate the scene shown in the launch photograph.[47] But what about the forensic evidence?

The Dutch RTL Nieuws contacted various forensic experts[48] to verify the smoke photograph's authenticity: the Fox-IT company, which focuses on cyber crime, and Eduard de Kam at the Dutch Institute of Digital Photography (NIDF). All of these consulted experts agreed on the same conclusion: there was "no indication of post-processing, fraud, or manipulation" in the photograph that showed the traces of a missile launch.[49] Additionally, two other organizations examined the photograph and determined the location of the launch site from the available information, coming to the same conclusion as Bellingcat, Ukraine@War, and others.

Looking to the launch site itself, journalists Christopher Miller and Roland Oliphant visited[50] the field south of Snizhne on July 22, 2014. The two found a burned field with various pieces of debris, including a piece of plastic from a weapons container manufactured by Steklo Plastik, which had its offices raided of approximately $25,000 worth of equipment by separatist soldiers about three weeks before the downing of MH17. Christopher Miller spoke with a resident of Chervonyi Zhovten, the nearest village from the field, who said that he saw and heard a missile launch from the field immediately before the downing of MH17.

"It was such a huge explosion," the 58-year-old said recently. "It felt like the end of the world!" The blast was the sound of a missile launcher, firing its weapon into the sky, he said. "It was a big missile and it wobbled as it flew right over our house in the direction of Torez," he added, pointing in a northwesterly direction. He said he watched as the missile struck a plane and fiery debris fell to the ground.

-Christopher Miller, *Mashable*

Satellite imagery of the site Miller and Oliphant visited also reveals that between July 16, 2014 and July 21, 2014 the corner of the field they visited was significantly altered,

45 https://www.youtube.com/watch?v=SkCcCmYlMZc
46 https://www.bellingcat.com/news/uk-and-europe/2015/01/27/is-this-the-launch-site-of-the-missile-that-shot-down-flight-mh17/
47 https://www.bellingcat.com/news/uk-and-europe/2015/07/16/in-their-own-words/
48 http://www.rtlnieuws.nl/nieuws/binnenland/hoe-onderzocht-rtl-nieuws-de-nieuwe-mh17-fotos
49 http://www.rtlnieuws.nl/nieuws/laatste-videos-nieuws/ooggetuige-mh17-ik-wil-dat-de-daders-gestraft-worden
50 http://mashable.com/2015/07/15/mh17-missile-launch-site

Figure 14: Field south of Snizhne between July 16 and 23 (Source Google Earth/Digital Globe)

and new track marks appeared in the area between those two dates.

On July 22, 2014, US intelligence officials published a black and white satellite map image depicting what they claimed to be the path of the Buk missile that downed MH17[51]. Although the quality of the US imagery is poor, it was possible to identify the launch site shown.
Using geographical landmarks in the US imagery, it was possible to identify the same landmarks in Google Earth satellite imagery, and from that determine the launch location. The image below shows origin point in the US imagery in relation to the field visited by Oliphant and Miller, which, again, is in line with the smoke in the photograph posted on Twitter.

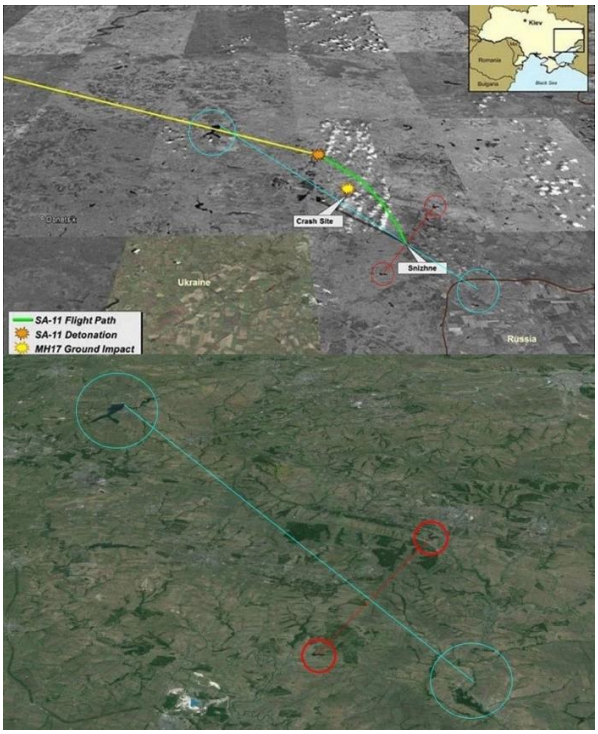


Figure 15: Identification of the origin point of the SBIRS data (top) with Google Earth (bottom)

Figure 16: Approximate origin point of SBIRS data

Further reading:

- Bellingcat: Is this the Launch Site of the Missile that Shot Down Flight MH17?
- Bellingcat: Examining the MH17 Launch Smoke Photographs
- Bellingcat: Interview with "WowihaY," the Man Who Narrated MH17 as it Happened
- *Meduza* (RU): The trace above Torez: From where did they shoot down the Malaysian Boeing
- *Mashable*: "It felt like the end of the world": How MH17 was brought down

[51] http://www.theguardian.com/world/2014/jul/22/mh17-us-intelligence-russia-separatists-report

- *Business Insider*: Local Ukraine Residents Say They Saw Rebels With Missiles Suspected of Taking Down Malaysia Plane
- RTL Nieuws: Hoe onderzocht RTL Nieuws de nieuwe MH17-foto's?

The Day After

On July 18, the Ukrainian Ministry of Interior published a video that was filmed in the separatist-controlled city of Luhansk, in which they claimed to show a Buk heading towards the Russian border on the morning of July 18.[52] The Buk had three missiles, instead of the four missiles a fully armed Buk usually carries, and as the Buk was photographed having in Makiivka, approximately five hours before the MH17 shootdown. Arsen Avakov, the Ukrainian Minister of Interior, later published the coordinates[53] of where the video was recorded, which were confirmed both by geolocation and news organizations visiting the site, including 60 Minutes Australia and Correctiv.[54]

Other than the Buk itself, the most obvious similarity to this video and the previous photographs and videos of the Buk in Ukraine is the white Volvo with red low-loader. This Volvo truck is hauling the Buk missile launcher in all of the sightings in eastern Ukraine on July 17, except after the Buk was unloaded in Snizhne. The truck can be recognized by the phone number on the red low-loader, the yellow Stroymekhanizatsiya elephant logo on the cabin, a blue stripe across the doors, and orange siren lights on top of the white cabin.

Figure 17: Frame from the July 18 2014 Luhansk video

52 https://www.youtube.com/watch?v=L4HJmev5xg0
53 https://goo.gl/e0YTuK
54 https://mh17.correctiv.org/mh17-the-path-of-the-buk/

Figure 18: Comparison of the truck in the Donetsk Paris Match photographs (left) and Luhansk video (right)

This Volvo was seized by separatists from the vehicle yard of Stroymekhanizatsiya, located in northern Donetsk. A 2013 video[55] filmed in Crimea shows this same Volvo being used, including the same yellow placard with a phone number.

Soon after the downing of MH17, journalists contacted the owner of the truck, confirming that the vehicle that hauled the Buk is the same that was captured by separatists in Donetsk:[56]

My base in Donetsk was taken over and it was parked there. Yes, this is my vehicle. They came to our base and said they needed it. Everyone left from the eighth (of July), and the base was under their control, including my equipment and that white truck.

Figure 19: Comparison of the truck filmed in 2013 (left) and photographed in Donetsk on July 17 2014 (right)

Satellite imagery from 11:08am on July 17, 2014[57] shows the low-loader was absent from the vehicle yard, supporting the fact that it was hauling the Buk through C at the time, while in imagery before and after July 17 the low-loader and truck was visible. If there is any remaining doubt that this truck that hauled the Buk on July 17

[55] https://www.youtube.com/watch?v=4N_jVKtG37A
[56] http://www.alfa.lt/straipsnis/472203/alfa-lt-isskirtinis-interviu-su-raketas-buk-kuriomis-buvo-numustas-malaizijos-avialiniju-lektuvas-gabenusio-vilkiko-savininku#.U-Ac4vmSx8F
[57] https://www.bellingcat.com/news/uk-and-europe/2015/06/30/low-loader/

and 18 was under the control of pro-Russian separatists, there are also photographs[58] and videos[59] of the Volvo and red low-loader under separatist control in the latter half of 2014.

Figure 20 - Truck seen on July 17 and 18 2014 photographed on August 6 2014

With all of this in mind, there is little doubt that the video filmed in Luhansk shows this same Volvo truck hauling a Buk missile launcher with only three, instead of four, missiles. Furthermore, we can establish that the route taken by the Volvo truck in this video was under the firm control of separatists. A July 15 convoy[60] transporting Russian military equipment from Donetsk, Russia, through Krasnodon, to Luhansk, and eventually to Donetsk, Ukraine[61] took that the Buk travelled on a route through Krasnodon on its way to Russia—mirroring the same route used on July 15. Lastly, both the July 15 convoy and July 18 Buk transport used the same route, Vulytsia Pavlivska-Nechuya Levytskoho, through Luhansk.

Further reading:

- Bellingcat: Who's Lying? An In-Depth Analysis of the Luhansk Buk Video
- Bellingcat: Tracking the Vehicle that Transported the MH17 Buk
- Bellingcat: Billy Six Interview – Investigating the Luhansk MH17 Buk Video

Origin of the Separatists' Buk

After the downing of MH17 and the emergence of witness accounts, photographs, and videos of a Buk in eastern Ukraine, it became increasingly clear that a Buk-M1 missile launcher was used to down the passenger plane. Now, the more difficult, but equally important, question must be addressed: where did this Buk come from, and which country did it belong to?

After the downing of MH17 members of the Bellingcat investigative team started their search for military convoys that included Buk missile launchers in the month July 17 2014. After searching through numerous convoys in Ukraine and Russia, a particular Buk-M1 TELAR stood out, belonging to Russia's 53rd Anti-Aircraft Missile Brigade. This Buk left from Kursk, Russia on June 23rd to near the Russia-Ukraine border, with the convoy last seen in Millerovo, Russia on June 25.

58 http://web.archive.org/web/20141101105122/http://informator.lg.ua/?p=18281
59 https://www.youtube.com/watch?v=U_If2yy0R_8
60 https://www.bellingcat.com/news/uk-and-europe/2016/03/04/8110/
61 https://www.google.com/maps/d/u/0/viewer?mid=zTZzTSNQv70A.kEBilOe_Evio

This Buk has many similarities with the one photographed and filmed in Ukraine on the day of the MH17 downing. This Buk seen in Russia was dubbed "3x2" due to an obscured number on the side of the vehicle. Since early investigations, we have been able to determine that this Buk was originally numbered 332 after comparing the various characteristics from photographs and videos going back to 2010.[62] The remaining fragments of the numbers of the Buk seen in the Paris Match images, as well as the railway transport markings, center of gravity mark, white paint on the rubber side skirt, and other features were in the exact same positions.[63]

Figure 21: Markings on Buk 3x2 filmed in Russia in June 2014 (left) and markings from the Buk in the Donetsk Paris Match photographs (right

Figure 22: White mark on Buk 3x2 in Russia in June 2014 (left) and the white mark on the Buk filmed in Luhansk, Ukraine on July 18 2014

Additionally, the white paint mark on the rubber side skirt, which was visible on both sides of the Buk, was also seen in the July 18 video of the Buk being transported in Luhansk.[64]

Outside of these marks being in the exact same locations on the two Buks, there is an additional, compelling method to compare the "identities" of the Buks. During our research into various Buk sightings, it became clear that the rubber side skirt above the caterpillar track

62 https://www.bellingcat.com/news/uk-and-europe/2016/05/03/the_lost_digit/
63 https://www.youtube.com/watch?v=wVl_wY7gISk
64 https://www.youtube.com/watch?v=asGgIR5OzME

sustain damage over time, creating a unique "fingerprint." Comparing these side skirt damage patterns, or "fingerprints," we can identify and match Buk missile launchers with one another. For example, below is a comparison of the side skirt fingerprints of a Russian Buk numbered 232. All three photographs were taken in the same year.

When comparing the side skirt profiles of Buk 332, the Russian Buk seen headed towards the Ukrainian border in late June, and the Buk photographed in eastern Ukraine on the day of the tragedy, there is a positive identification:

Figure 23: Side skirt comparison of Russian Buk 232 over a period of a year

The strong "spike" in the waveform below the white marking (which reads "H-2200," a code used for oversized railway cargo frequently found on Russian military equipment) can be identified by examining photographs of the Buk in Russia and Ukraine.

This tear on the rubber side skirt can be identified in the exact same location on the Buk seen in Ukraine. Over the past two years, members of the Bellingcat investigation team have compared the features of Buk 332, seen both in Russia and Ukraine in the summer of 2014, with every other Buk photographed or filmed in 2013 and 2014 in Russia and Ukraine discovered by investigators. No other Buk has even half of the same details seen on this Buk, including the number, exact placement of the various white marks, the side skirt "fingerprint"

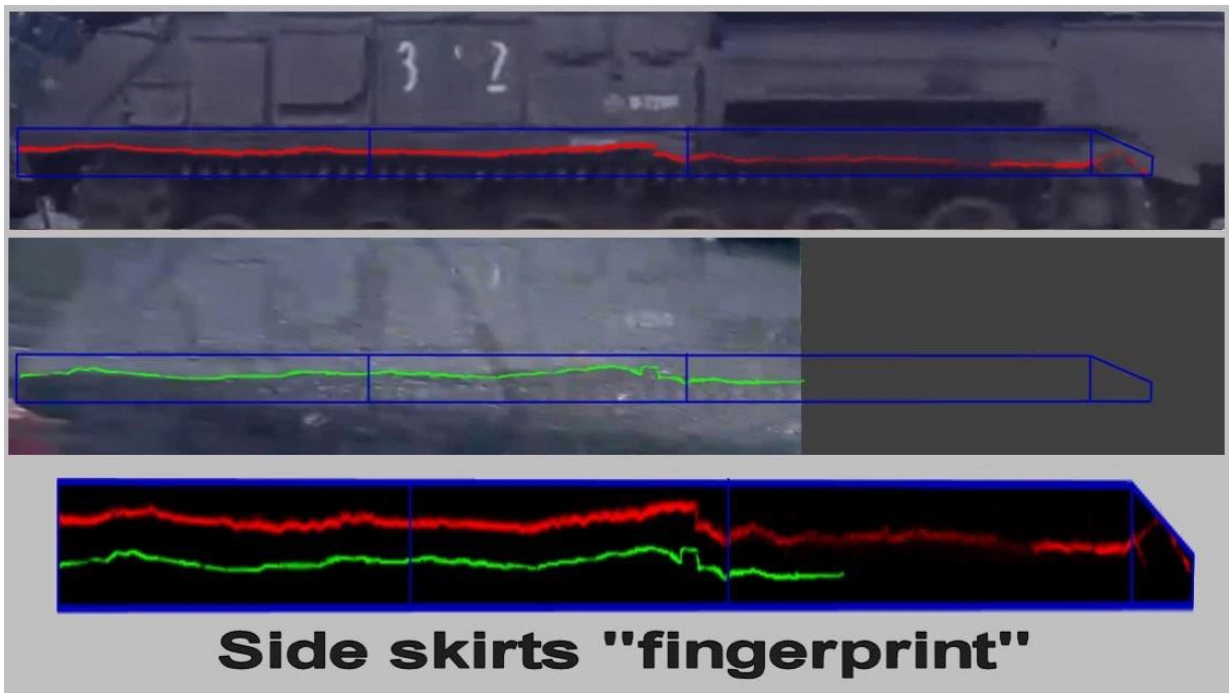


Figure 24: Side skirt comparison between June and July 2014 of Buk 3x2 and the Buk in the Paris Match photographs.

Figure 25: Damage to the side skirt visible on Buk 3x2

profile, and other features. Russian Buk 332 of the 53rd Anti-Aircraft Missile Brigade is the same Buk photographed and filmed in eastern Ukraine on July 17 and 18, 2014.

Further reading:

- Bellingcat: Origin of the Separatists' Buk
- Bellingcat: The Lost Digit: Buk 3x2
- Bellingcat: The Latest Open Source Theories, Speculations and Debunks on Flight MH17
- Bellingcat: Geolocated June BUK convoy videos in Russia

- Bellingcat: Geolocated July BUK convoy videos in Russia
- Bellingcat: Video Comparison Confirms the Buk Linked to the Downing of MH17 Came from Russia
- Bellingcat: MH17 Joint Investigation Team's New Video Brings New Facts to Light
- Novaya Gazeta (RU): It was a "Buk-M1"

Tracking the 53rd Brigade Convoy

The full power of open source information gathering can be seen in the reconstruction of the convoy of the 53rd Anti-Aircraft Missile Brigade from their base near Kursk to the Russia-Ukraine border in June 2014.

This convoy, which included Buk 332, was photographed and filmed by ordinary Russian civilians who lived along this convoy's route. Each of the images and videos were geolocated to the exact location where it was captured, providing an accurate representation of the convoy's route.

It was possible to confirm which members and battalions of the 53rd Brigade were part of the convoy. Furthermore, Bellingcat's research into the convoy identified the military transport battalions involved in the convoy, including the identities of individuals[65] who could have driven the vehicle transporting Buk 332. The information published on Bellingcat, and additional unpublished information, has been provided to the Dutch-led Joint Investigation Team investigating the downing of MH17.

Figure 26: Geolocated photographs and videos of the June 23 - 25 2014 convoy in Russia

[65] https://www.bellingcat.com/news/uk-and-europe/2015/05/13/tracking-the-trailers-investigation-of-mh17-buks-russian-convoy/

	Combat Weapons			Combat Weapons		
Brigade	**1st Battalion**	**Crew**	**No.**	**1st Battalion - 1st Battery**	**Crew**	**No.**
	Command post (CP) 9S470M1-2	6	100	Missile launcher with radar (TELAR) 9A310M1-2	4	111
	Snow Drift radar (Kupol) 9S18M1-1	3	101	Missile launcher with radar (TELAR) 9A310M1-2	4	112
	BTR 80	3 + 7	993	Missile launcher with crane (TEL) 9A39M1	3	113
Hardware	**Hardware System**			**Combat Weapons**		
Mobile automated control and test station ACIS 9V930M-1	Car maintenance (MTO) 9V884M1			**1st Battalion - 2nd Battery**	**Crew**	**No.**
	Workshop maintenance MTO-ATG-M1			Missile launcher with radar (TELAR) 9A310M1-2	4	121
	Car repair and maintenance (MRTO)			Missile launcher with radar (TELAR) 9A310M1-2	4	122
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with crane (TEL) 9A39M1	3	123
	Transport machines for Missiles (TM) 9T243	8	Missiles	**Combat Weapons**		
	Transport machines for Missiles (TM) 9T243	8	Missiles	**1st Battalion - 3rd Battery**	**Crew**	**No.**
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with radar (TELAR) 9A310M1-2	4	131
	Compressor station UKS - 400V-P4M			Missile launcher with radar (TELAR) 9A310M1-2	4	132
	Mobile power PES - 100-T / 230-B / 400 A1RK1			Missile launcher with crane (TEL) 9A39M1	3	133
	Combat Weapons			**Combat Weapons**		
	2nd Battalion	**Crew**	**No.**	**2nd Battalion - 1st Battery**	**Crew**	**No.**
	Command post (CP) 9S470M1-2	6	200	Missile launcher with radar (TELAR) 9A310M1-2	4	211
	Snow Drift radar (Kupol) 9S18M1-1	3	201	Missile launcher with radar (TELAR) 9A310M1-2	4	212
	BTR 80	3 + 7		Missile launcher with crane (TEL) 9A39M1	3	213
	Hardware System			**Combat Weapons**		
	Car maintenance (MTO) 9V884M1			**2nd Battalion - 2nd Battery**	**Crew**	**No.**
	Workshop maintenance MTO-ATG-M1			Missile launcher with radar (TELAR) 9A310M1-2	4	221
	Car repair and maintenance (MRTO)			Missile launcher with radar (TELAR) 9A310M1-2	4	222
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with crane (TEL) 9A39M1	3	223
	Transport machines for Missiles (TM) 9T243	8	Missiles	**Combat Weapons**		
	Transport machines for Missiles (TM) 9T243	8	Missiles	**2nd Battalion - 3rd Battery**	**Crew**	**No.**
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with radar (TELAR) 9A310M1-2	4	231
	Compressor station UKS - 400V-P4M			Missile launcher with radar (TELAR) 9A310M1-2	4	232
	Mobile power PES - 100-T / 230-B / 400 A1RK1			Missile launcher with crane (TEL) 9A39M1	3	233
	Combat Weapons			**Combat Weapons**		
	3rd Battalion	**Crew**	**No.**	**3rd Battalion - 1st Battery**	**Crew**	**No.**
	Command post (CP) 9S470M1-2	6	300	Missile launcher with radar (TELAR) 9A310M1-2	4	311
	Snow Drift radar (Kupol) 9S18M1-1	3	301	Missile launcher with radar (TELAR) 9A310M1-2	4	312
	BTR 80	3 + 7		Missile launcher with crane (TEL) 9A39M1	3	313
	Hardware System			**Combat Weapons**		
	Car maintenance (MTO) 9V884M1			**3rd Battalion - 2nd Battery**	**Crew**	**No.**
	Workshop maintenance MTO-ATG-M1			Missile launcher with radar (TELAR) 9A310M1-2	4	321
	Car repair and maintenance (MRTO)			Missile launcher with radar (TELAR) 9A310M1-2	4	322
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with crane (TEL) 9A39M1	3	323
	Transport machines for Missiles (TM) 9T243	8	Missiles	**Combat Weapons**		
	Transport machines for Missiles (TM) 9T243	8	Missiles	**3rd Battalion - 3rd Battery**	**Crew**	**No.**
	Transport machines for Missiles (TM) 9T243	8	Missiles	Missile launcher with radar (TELAR) 9A310M1-2	4	331
	Compressor station UKS - 400V-P4M;			Missile launcher with radar (TELAR) 9A310M1-2	4	332
	Mobile power PES - 100-T / 230-B / 400 A1RK1			Missile launcher with crane (TEL) 9A39M1	3	333

Figure 27: Organizational structure of the 53rd Anti-Aircraft Missile Brigade

Members of the 53rd Brigade

The 53rd Anti-Aircraft Missile Brigade was originally linked to Buk 332 by matching vehicles present in the June 23 – 25 convoy with vehicles visible in photographs taken by members of the 53rd Brigade[66] at their base near Kursk. Bellingcat spent nearly one and a half years investigating the 53rd Brigade. With over 200 soldiers' social media profiles identified, it has been possible to confirm the identity and roles of many members of the 53rd Brigade and their involvement in the June convoy that transported Buk 332 to the Russia-Ukraine border.

The 53rd Brigade is made up of three battalions: the 1st, 2nd, and 3rd. The 1st and 2nd Battalions were active in the summer of 2014, while the 3rd Battalion was used for training. The 2nd Battalion was responsible for the transport of Buk 332, which replaced the 2nd Battalion's missile launcher numbered 222 in the convoy. The organizational structure of the 53rd Anti-Aircraft Missile Brigade is shown above.

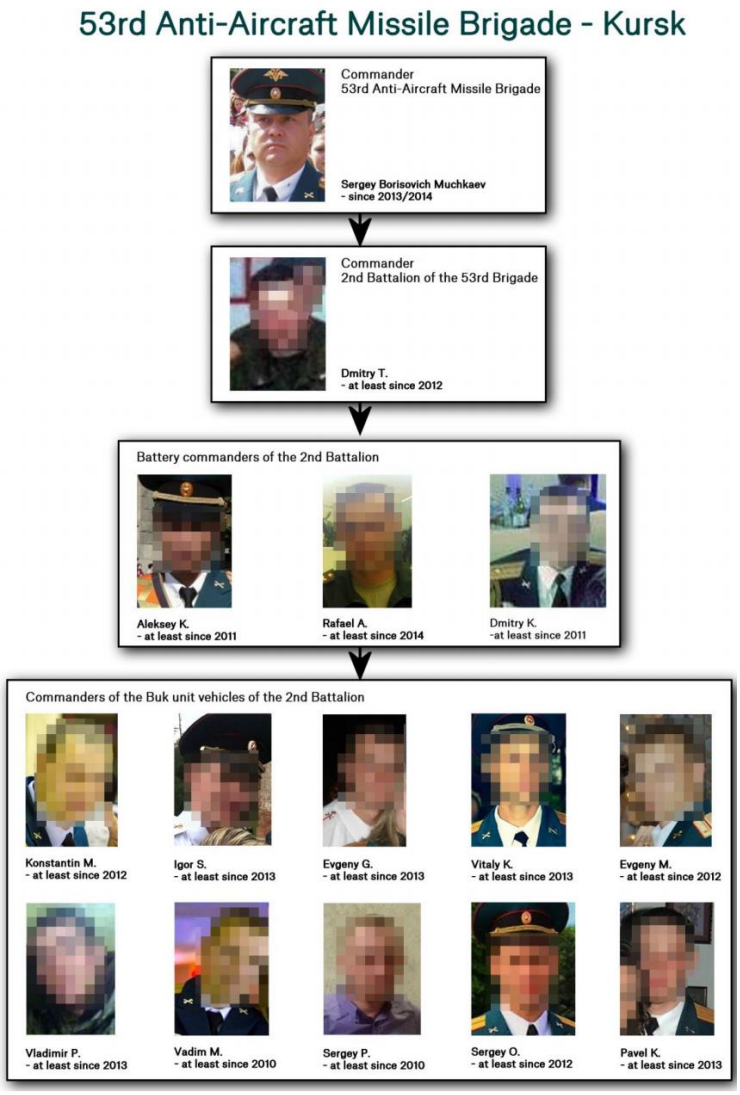


Figure 28: Members of the 53rd Anti-Aircraft Missile Brigade, including the publicly known commander (Sergei Muchkaev) and officers whose identities we have concealed for privacy.

Information regarding the commanders and soldiers of the 53rd Brigade can be found in Bellingcat's February 2016 report, Potential Suspects and Witnesses from the 53rd Anti-Aircraft Missile Brigade.[67] An uncensored version of this report, which reconstructed the leadership structure of the brigade and identified specific individuals who were most likely in command of Buk 332 and held decision-making power in sending a Buk into Ukraine, was provided to the Dutch-led Joint Investigation Team, the criminal investigation into the downing of MH17.

[66] https://www.bellingcat.com/news/uk-and-europe/2014/11/08/origin-of-the-separatists-buk-a-bellingcat-investigation/
[67] https://www.bellingcat.com/news/uk-and-europe/2016/02/23/53rd-report-en/

Further reading:

- Bellingcat: Potential Suspects and Witnesses from the 53rd Anti-Aircraft Missile Brigade
- Bellingcat: Exploring Russia's 53rd Brigade's MH17 Convoy with Storymap

The Response from Russia

In the two years since the downing of MH17, a wide range of theories and claims about the circumstances surrounding the crash have been proposed by a range of sources. This section of the report will focus on those claims coming from Russia, focusing on the Russian government and the Russian government-owned Buk missile manufacturer Almaz-Antey. While there are many more claims from blogs, news sites, and conspiracy theorists, this report focuses on what can be considered official Russian government sources.

The Immediate Kremlin Reaction

On July 21, 2014, the Russian Defence Ministry (MoD) gave a press conference[68] in which they presented their evidence[69] on MH17 regarding who may have been responsible for the attack. Their evidence uniformly pointed towards the Ukrainian government, but in the Russian argument, the methods by which the attack was conducted was not consistent. In its press conference, the Russian MoD made four primary claims:

- The video published by the Ukrainian Ministry of Interior showing a Buk in separatist-controlled Luhansk was in fact filmed in government-controlled Krasnoarmeysk.
- MH17 changed its course significantly just before being shot down.
- Radar imagery shows an aircraft close to MH17 shortly after it was shot down.
- Satellite imagery shows Ukrainian Buk missile launchers missing from their base and deployed dozens of kilometers away on July 17 in eastern Ukraine.

Since the July 21 press conference, it has been possible to establish that all four claims were false, and, in some cases, the Russian Defence Ministry produced fabricated evidence to support their claims.

1. The Luhansk Video

In the Russian Defence Ministry's July 21 press conference, they claimed[70] that the video posted by the Ukrainian Ministry of Interior showing a Buk in Luhansk on July 18 had actually been filmed in a government-controlled city:

68 http://archive.mid.ru//brp_4.nsf/0/ECD62987D4816CA344257D1D00251C76
69 https://youtu.be/4bNPInuSqfs
70 https://www.youtube.com/watch?v=4bNPInuSqfs#t=1567

For example, media circulated a video supposedly showing a Buk system being moved from Ukraine to Russia. This is clearly a fabrication. This video was made in the town of Krasnoarmeisk, as evidenced by the billboard you see in the background, advertising a car dealership at 34 Dnepropetrovsk Street. Krasnoarmeisk has been controlled by the Ukrainian military since May 11.

Figure 29: Comparison between the billboard text presented by the Russian Defence Ministry (top), and the actual text (bottom)

However, it was possible to establish the true location the video was filmed using open source investigation techniques, which confirmed the billboard's exact location in separatist-controlled Luhansk. This location was visited by a Luhansk local who took photographs of the area which both helped confirm the location, and what was written on the billboard.

It is clear that not only was the location claimed by the Russian Defence Ministry incorrect, but the billboard's text is very different from the text the Russian Defence Ministry claimed was on the billboard. The location was also confirmed as being in Luhansk by a number of news organisations and journalists who visited the location.[71] Freelance journalist Billy Six not only visited the site, confirming the location, but also met the woman who claims to have filmed the Luhansk video.[72]

2. MH17's Significant Change in Course

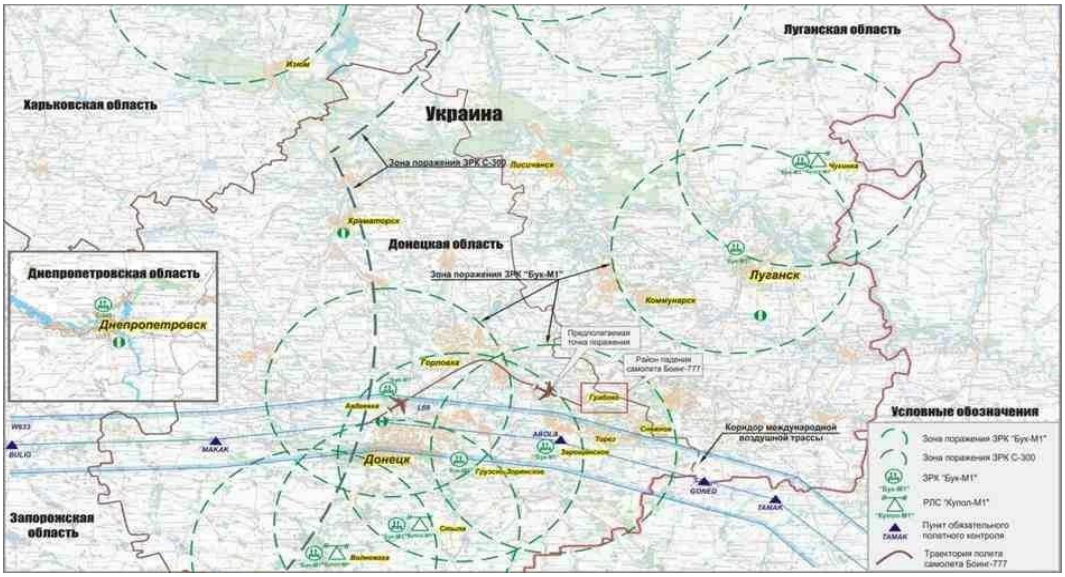


Figure 30: Flightpath presented by the Russian Defence Ministry

[71] https://www.bellingcat.com/news/uk-and-europe/2015/05/29/whos-lying-an-in-depth-analysis-of-the-luhansk-buk-video/

[72] https://www.bellingcat.com/news/uk-and-europe/2015/08/13/billy-six-interview-investigating-the-luhansk-mh17-buk-video/

The Russian Defence Ministry presented the following image during the press conference, claiming that MH17 had significantly diverted from its course (see previous image.

The Russian Defence Ministry stated that:

On the scheme you can see the international airway. The Boeing-777 was supposed to fly on this airway. Draw your attention to the fact that the aircraft followed inside the specified air-corridor to Donetsk, then it deviated from the route to north. Meanwhile the maximum distance from the left border of the air-corridor was 14 kilometers. Then we can see that the Boeing-777 turned back to the borders of the specified air-corridor. Nevertheless Malaysian aircrew didn't succeed the maneuver. At 17.20 we entered the event of the aircraft rate reduction, at 17.23 the aircraft's point blinked off on the radar. Why did the aircraft cross the border of the air-corridor? Was it the navigation mistake, or the aircrew followed the Dnepropetrovsk ground control orders? We will find the answers after "black boxes" and communication decoding.

Section 2.1 Dutch Safety Board report[73] answered the questions that the Russian Defence Ministry asked, showing that MH17 had been on an entirely different course than that which was claimed by the Russian Defence Ministry and had not changed course in the way described in the Russian Defence Ministry's imagery. Unlike other parts of the Dutch Safety Board report, the Russian government did not challenge the Dutch Safety Board's claims regarding the flight path.

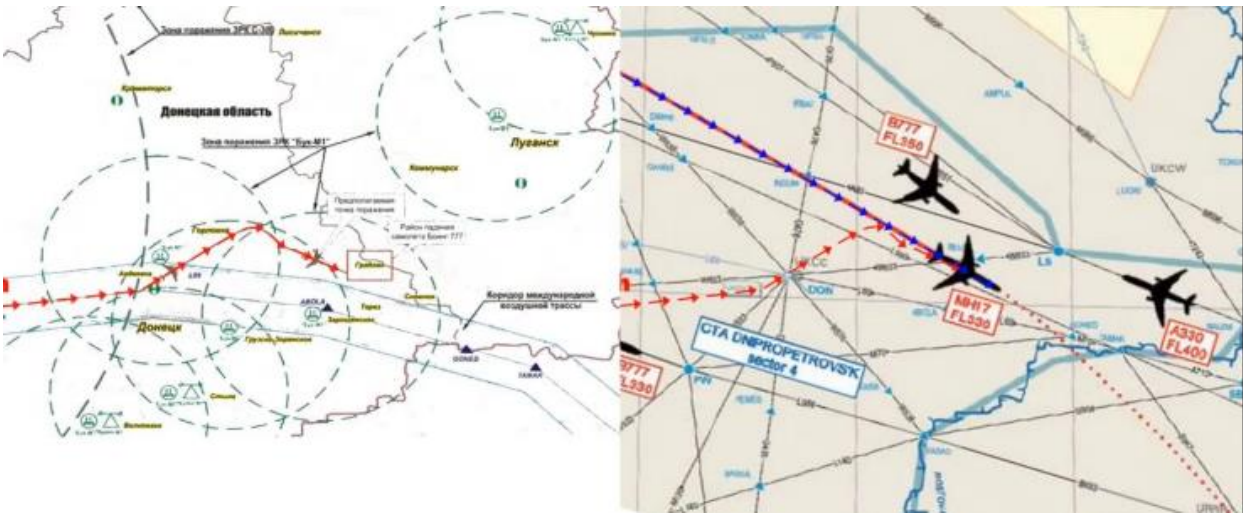


Figure 31: Russian Defence Ministry flight path (left), actual flight path (in blue, right)

3. Russia's Radar Data

The Russian Defence Ministry also presented radar data showing MH17 and claimed "Russian system of air control detected the Ukrainian Air Force aircraft, purposed Su-25, moving upwards toward to the Malaysian Boeing-777. The distance between aircrafts was 3-

[73] http://www.onderzoeksraad.nl/uploads/phase-docs/1006/debcd724fe7breport-mh17-crash.pdf

5 kilometers." Chief of Staff of the Air Force Lieutenant-General Igor Makushev was then invited to comment on the radar data:

At 17.20 P.M. at the distance of 51 kilometers from the Russian Federation state boundary and the azimuth of 300 degrees the aircraft started to lose its speed obstructively which is quite distinctively to be seen on the table of the aircraft characteristics. At 17.21 35 seconds P.M. with the aircraft speed of 200 km/h at the point of the Boeing crash there is a new mark of the aircraft to be seen. The aircraft was steadily monitored by radar stations of Ust-Donetsk and Butirinskoe during 4 minutes period. Air control officer having enquired the characteristics of newly appeared aircraft couldn't possibly get them because it is in all likelihood that the aircraft had no secondary deduction system amounted on it, which is put typically for military aircraft. The early detection of this aircraft appeared to be quite impossible because the air situation control is usually performed by radars working in a standby mode which detection possibilities at the given distance are over 5000 m altitude. The detection of the aircraft turned out to be possible as the aircraft ascend it.

However, radar experts were interviewed by a number of news organizations who gave a different opinion, with Dutch NOS news[74] asking four experts to give their opinions. Comments included, "it is really impossible for [it to be] a fighter," "no aircraft was in the vicinity of flight MH17," "it seems likely that the signals are the wreckage of MH17," and "falling debris are the most likely explanation." The BBC documentary *The Conspiracy Files, Who Shot Down MH17?* included the former air accident investigator David Gleave who stated, "I've seen a lot of radar data in my time as an investigator and when aircraft break up in mid-air some of the time they can continue to transmit radar data on the way down. They may well change direction, because they've lost the tail or something like that, so they don't the stability to carry on in a straight line." The Dutch Safety Board also stated had "explicitly ruled out…the presence of military aircraft in the immediate vicinity of flight MH17" and "within 30km of flight MH17 no (military) aircraft were present at the time of the crash."[75]

[74] http://nos.nl/nieuwsuur/artikel/2030649-geen-straaljager-te-zien-op-russische-radarbeelden-mh17.html
[75] https://www.bellingcat.com/news/uk-and-europe/2016/02/25/dsb-responses/

4. Russian Satellite Imagery

Russia also presented sets of satellite imagery showing three different locations, including two military bases and a field outside the town of Zaroshchenske. At one military base near Donetsk, the A-1428, it was claimed that images from July 14 and July 17 showed that a Buk missile launcher had moved from the base on July 17. Oleg Storchevoy, the deputy head of the Federal Air Transport Agency, which represented the Russian Federation during the Dutch Safety Board investigation into MH17, stated in a February 2016 statement that these images

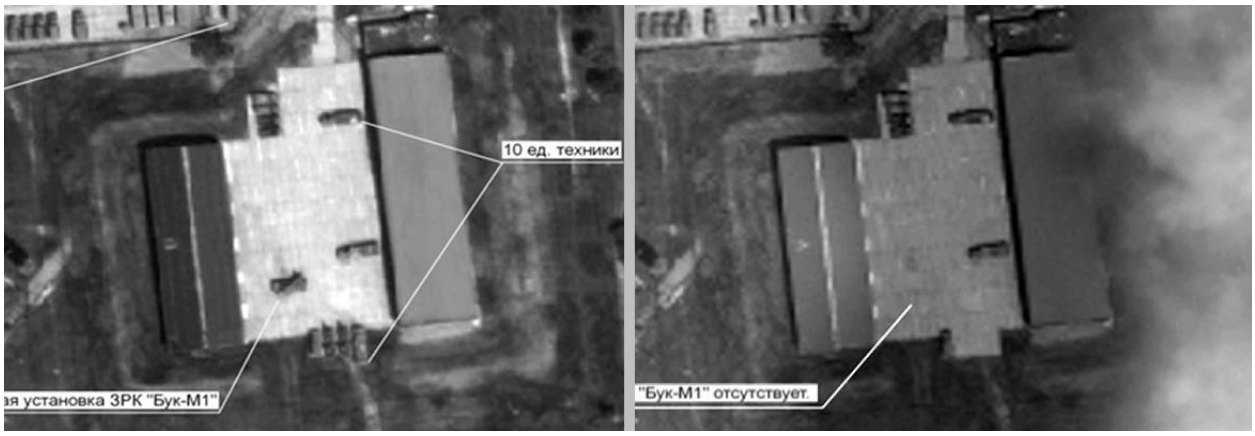


Figure 32: Sections of Russian Defence Ministry satellite imagery showing the position of a Buk missile launcher on July 14 2014 and July 17 2014

"confirm, among other things, that there was movement and increased activity by Ukrainian Buk surface-to-air missile systems observed within the conflict area in Eastern Ukraine one day ahead of the tragedy."[76]

Figure 33: Comparison of missing vegetation on different dates to Russian Defence Ministry satellite imagery

[76] https://www.rt.com/politics/official-word/331834-mh17-russia-storchevoy-letter/

However, comparisons of available Google Earth historical imagery of the same location on July 17 show a number of clear discrepancies. For example, large areas of vegetation visible in the July 14 Ministry of Defense images were absent from the July 17 Google Earth image.

Historical satellite imagery of the same location from July 2 and 21 of the same area on Google Earth confirms that the vegetation had been cleared weeks before July 17. Patches of worn-away grass visible in the Russian Defence Ministry imagery were also absent in the Google Earth July 17 imagery.

But, as with some of the other discrepancies between the images, the patches of missing grass were visible in earlier historical imagery on Google Earth, clearly showing the Russian Defence Ministry images were from weeks before MH17 was shot down.

An analysis from two analysts at the American Association for the Advancement of Science (AAAS) provides additional evidence that the Russian Defence Ministry purposefully misdated the images, as they could not have possibly been taken at the time claimed.

Figure 34: Comparison of Digital Globe July 17 2014 imagery to Russian Defence Ministry July 14 and 17 2014 satellite imagery

Figure 35: Comparison of May 30 2014 Digital Globe imagery and Russian Defence Ministry satellite imagery dated July 14 and 17 2014

AAAS Analysis

In Spring 2016 Bellingcat contacted the Geospatial Technologies Project at the American Association for the Advancement of Science (AAAS)[77] with a request to independently review the satellite images provided by the Russian Defence Ministry on July 21 2014. AAAS tasked two analysts who each independently reviewed these images, and the AAAS responded to Bellingcat with details of their findings. The following is a summary of those findings.

AAAS were provided with Digital Globe images of the Ukrainian A1428 military base on June 7 2014 and July 17 2014.[78] The AAAS analysts applied shadow analysis techniques to examine the Digital Globe and Russian Defence Ministry imagery of the A1428 military base, with the first step being to determine how accurately the solar azimuth and elevation could be derived from the features present in each image. Three points were identified that were visible in Russian Defence Ministry Imagery and the Digital Globe imagery, two poles on an archway, and a tall tree located southeast of the archway.

Figure 36: Image highlighting the object used to measure solar azimuth

[77] http://www.aaas.org/geotech
[78] The July 17 2014 image is available as historical imagery on Google Earth.

The azimuth of shadows cast by each object were measured twice in respect to true north, the measurements were then averaged and converted into solar azimuth by subtracting 180 degrees. The figures were then compared to the solar azimuth reported by the image's metadata, as well as results of the online solar position calculator provided by the National Oceanic and Atmospheric Administration (NOAA).[79] Analysts used this analysis to evaluate whether the timeline suggested by the Russian Defence Ministry was plausible.

First examining the June 7 2014 and July 17 2014 Digital Globe images analysts found the solar azimuth in the metadata and NOAA solar azimuth were identical, with the mean solar azimuth deviating from between 0.20 and 1.85 degrees on the archway's poles, and 3.15 to 4.80 on the tree. The great deviation was stated to be likely due to the trees irregular shape reducing the accuracy of the measurement.

The Russian Defence Ministry's imagery was then examined. The Russian imagery did not contain metadata with solar azimuth information. The time stated on the imagery was converted to Zulu time, with the assumption the time was referring to Moscow Time, which is also the local time in Eastern Ukraine. Using the NOAA calculator, the expected solar azimuth was calculated, and the deviation calculated based on the shadows visible in the Russian Defence Ministry imagery.

The July 14 2014 Russian Defence Ministry image of the A1428 base was found to have a mean azimuth deviation of 15.91 and 11.41 on each pole, and 7.41 on the tree, while the July 17 2014 image, where only the tree is visible, had deviation of 9.76.
This significant discrepancy would indicate that either the time on the image is incorrect, the date on the image is incorrect, or both the time and date are incorrect.

After publishing these images, it was discovered that the same satellite imagery had been published by the SBU in July 2014. The Russian Defence Ministry responded by claiming that the SBU was presenting falsified images[80]. However, it is clear that the SBU images are genuine[81] (although something with the RGB color channels inverted to BGR for an unknown reason), and that the Russian Defence Ministry presented and defended images that are purposefully dated incorrectly, and heavily edited.

[79] http://www.esrl.noaa.gov/gmd/grad/solcalc/azel.html
[80] http://mil.ru/analytics.htm; http://eng.mil.ru/en/analytics.htm
[81] The images presented by the SBU are now viewable on Google Earth.

The Almaz-Antey Alternative

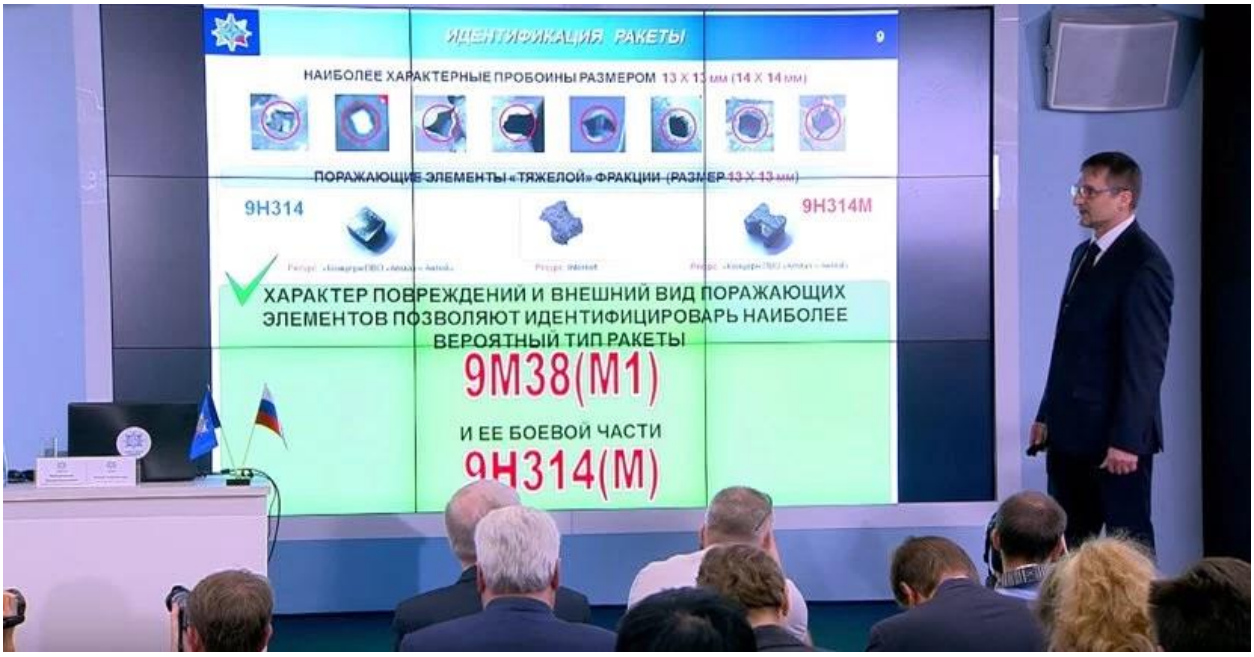


Figure 37: Almaz-Antey presentation

The state-owned Russian arms company, Almaz-Antey, manufactures Buk missile systems, and was directly affected by sanctions placed on Russia. In response, this arms manufacturer has given two inconsistent presentations related to the downing, in which two different missiles types are presented as having downed MH17, and a flashy experiment in which the position of the missile was supposedly determined. On June 2, 2015 Almaz-Antey presented evidence claiming to show the specific type of missile used to shoot down MH17 in Ukraine. They were quoted as stating:[82]

If a surface-to-air missile system was used [to hit the plane], it could only have been a 9M38M1 missile of the BUK-M1 system.

They went on to add:

[82] https://www.rt.com/news/264421-buk-missile-manufacturer-investigation/

Production of BUK-M1 missiles was discontinued in 1999, at the same time Russia passed all such missiles that were left to international clients.

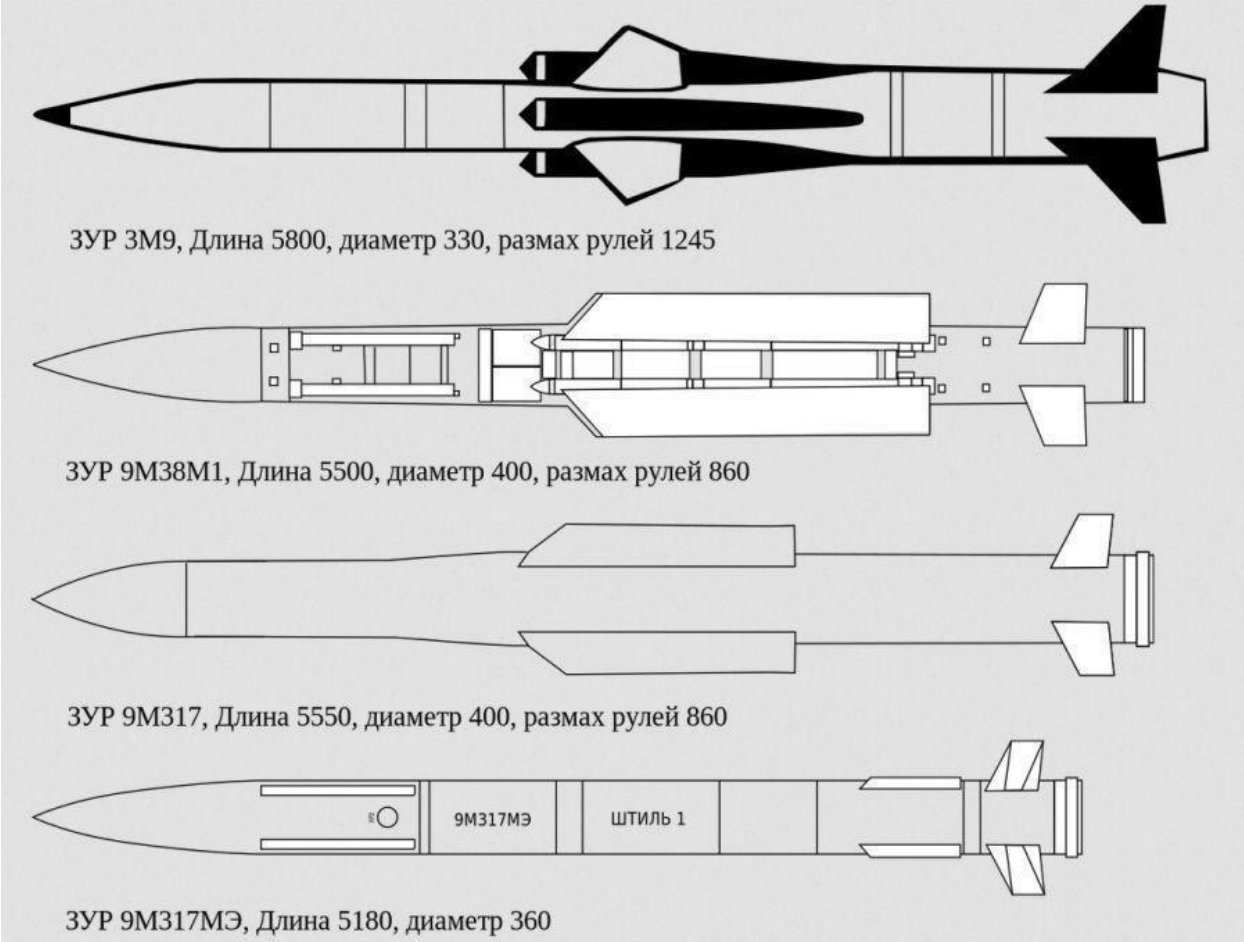


Figure 38: Comparison of different surface to air anti-aircraft missiles

The clear implication was that the Buk missile used to shoot down MH17 could have not come from Russia. The most obvious visual difference between the 9M38M1 missile, and the newer 9M317 is the length of the fins, with the 9M38M1 having longer fins, as visible above.

Despite these longer fins being visible on Buk missiles loaded onto launchers at Russia's Victory Day Parade in Chita,[83] the Almaz-Antey's head, Yan Novikov claimed "that only the newer BUK-M2 systems with 9M317 missiles take part in modern parades," adding, "even an untrained eye can tell the two apart." Despite this claim, internet users came across numerous images[84] of what seemed to be 9M38M1 missiles in military service.

Reuters photographs[85] taken on a road near Kamensk-Shakhtinsky, dated August 16, 2014, shows Russian military vehicles heading toward the town, close to the Ukrainian border.

[83] https://www.youtube.com/watch?v=yymGgn2cfG0
[84] https://www.bellingcat.com/news/uk-and-europe/2015/06/03/evidence-the-russian-military-supplied-the-type-of-missile-used-to-shoot-down-mh17/
[85] http://uk.reuters.com/news/picture/west-faces-tough-choices-if-russia-ukrai?articleId=UKKBN0GG06M20140816&slideId=964530682

Trucks in the photographs are carrying a number of missile crates, and their markings give a clear indication of their likely contents.

Figure 39: Magnified sections of photographs taken at Kamensk-Shakhtinsky in August 2014 (Source - Reuters)

These crates are marked 9M38M1, and it was also possible to identity two vehicles in the Reuters' photographs as being part of the June 23 – 25 53rd Brigade convoy transporting Buk 3×2 to Millerovo.[86] It is also possible to identify missiles in videos[87] of the 53rd Brigade convoy as having the long tail fins associated with the 9M38M1 missile.

Further reading:

- Bellingcat: Forensic Analysis of Satellite Images Released by the Russian Ministry of Defense
- Bellingcat: Evidence the Russian Military Supplied the Type of Missile Used to Shoot Down MH17
- Bellingcat: New July 17th Satellite Imagery Confirms Russia Produced Fake MH17 Evidence
- Bellingcat: Russia's Colin Powell Moment – How the Russian Government's MH17 Lies Were Exposed

86 https://www.bellingcat.com/news/uk-and-europe/2015/06/03/evidence-the-russian-military-supplied-the-type-of-missile-used-to-shoot-down-mh17/

87 https://youtu.be/OJPxt7XrG6Q?t=77

The Phantom Launch Site

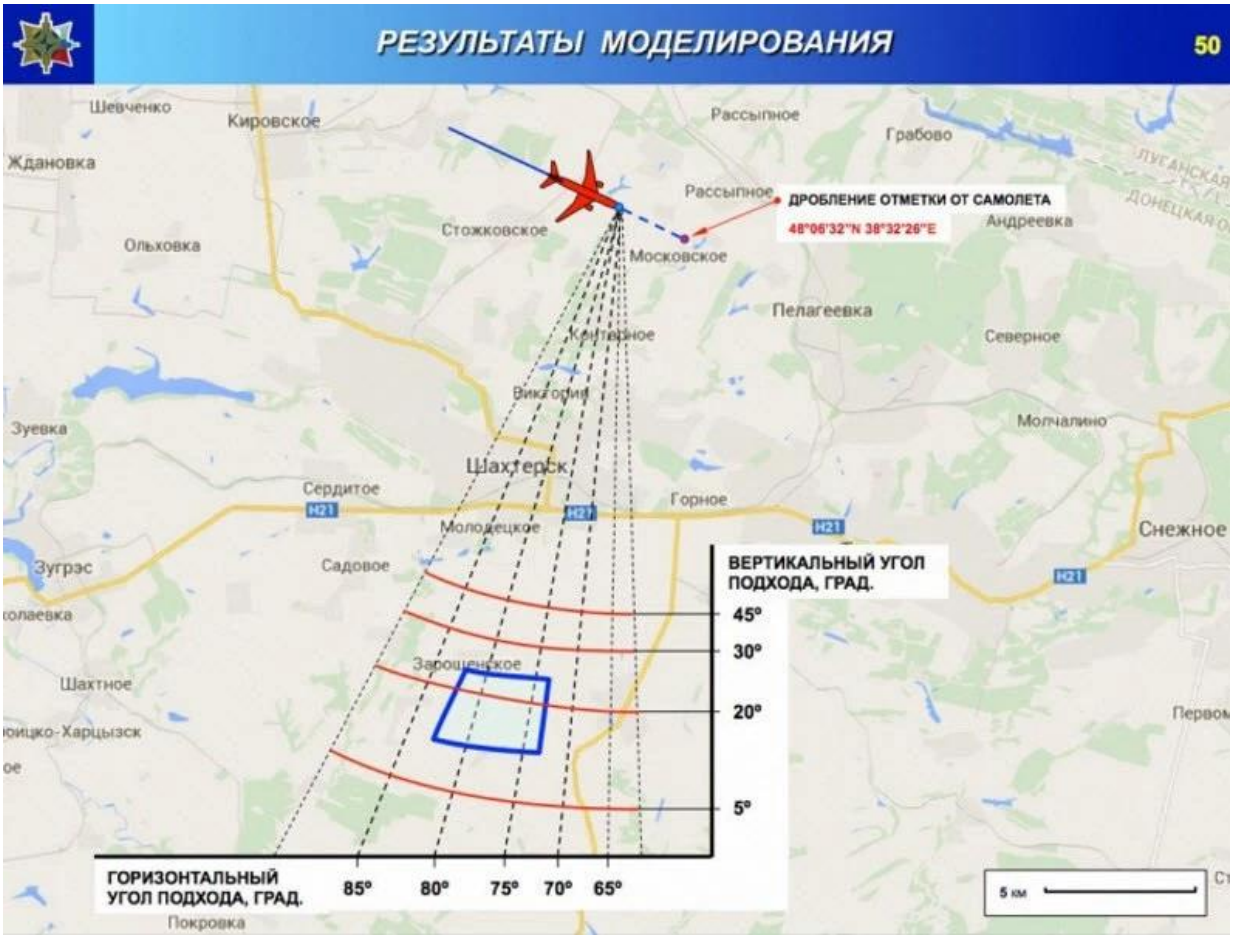


Figure 40: Almaz-Antey's proposed launch site

In its two press conferences, Almaz-Antey has given two different, but similar, launch locations for the Buk missile that downed MH17. Both are near the village of Zaroshchenske, and while there is no documented pro-Russian military presence in the village itself, the area south of the village was under pro-Russian control.

The Russian Defence Ministry has also pointed to the first launch site proposed by Almaz-Antey, as evidenced in their fabricated satellite images showing Buk missile launchers deployed in a field just outside of the village on July 17, 2014.
Before examining much of the evidence surrounding the claims of the Russian Defence Ministry and Almaz-Antey, the most direct and obvious evidence should be considered: witness accounts from the village of Zaroshchenske. While there are dozens of witness accounts, photographs, and videos of a Buk missile launcher between Donetsk and Snizhne on July 17, we do not have a single witness account – reliable or otherwise – of a Buk missile launcher or launch near Zaroshchenske on July 17. Multiple media outlets, including the

Russian newspaper Novaya Gazeta,[88] the BBC,[89] the Dutch television station NOS,[90] and the German investigative group Correct!v,[91] all interviewed locals in and around Zaroshchenske – not a single person mentioned seeing or hearing anything resembling a missile launch.

But many villagers have other worries. "I have cows that need to be milked every day," says a woman who stands by the gate of her farm in a headscarf and jacket. She was also in Zaroshchens'ke on July 17th and did not notice anything. She received an excited call from a relative in Moscow after the press conference. But no: "All nonsense, nothing happened here." Up until now they have been spared from the war, only one rocket flew over the town at the end of July. "We ran into the basement with the children," a resident said. The villagers gather on the street. Nobody saw anything, nobody heard anything. There was no BUK missile fired in Zaroshchens'ke on July 17th 2014. Definitely not by the Ukrainian army because separatists control the fields around Zaroshchens'ke."

-Correct!v

These witness accounts alone go far in disputing the Russian Defence Ministry and Almaz-Antey accounts. However, if one believes that the witnesses were mistaken, or just happened to miss a missile launch in their sleepy village that had been largely untouched by war, then there is additional evidence to consider.

Satellite images captured on July 16, 2014 and July 21, 2014 show no signs of any track marks from the movements of large vehicles or burn marks from missile launches at the site shown in the Russian Defence Ministry satellite imagery. In addition, satellite imagery analysis by Dr. Jeffrey Lewis using the Tungstène forensic imagery analysis software shows the Russian Defence Ministry imagery of the area close to Zaroshchenske are heavily modified, and it appears as if the Buk missile launchers features were digitally altered or added into the image.

Figure 41: Area within Almaz-Antey's proposed launch site compared to Russian Defence Ministry satellite imagery

88 http://www.novayagazeta.ru/inquests/68728.html
89 http://www.bbc.com/news/world-europe-33549845
90 http://nos.nl/uitzending/9368-nos-journaal.html
91 https://mh17.correctiv.org/english/

The James Martin Center for Non-Proliferation Studies at the Middlebury Institute of International Studies at Monterey offered an independent analysis of various images related to the MH17 case. This includes the original images of the smoke trail, photographs of the Buk taken on July 17 2014 in Donetsk, Torez, and Snizhe, and the satellite images presented by the Russian Defence Ministry. The Center uses the sophisticated imagery analysis software Tungstène to examine imagery for signs of digital alteration, with the same software used by police and security services across the world for forensic analysis. While the Buk and smoke photographs showed no signs of alteration, the Russian Defence Ministry images did.[92]

The Russian Defence Ministry satellite image of the Ukrainian A-1428 base dated July 17, 2014 showed that one or possibly both of the clouds in the image had been added or altered, with the large cloud on the left portion of the image showing particularly strong results in various analytical filters. This analysis showed significant differences in photographic noise, compression, and signs of cloning. The Center concludes "even with the low quality of the image, we can assess this image to have been so heavily manipulated that it lacks any credibility as evidence."
The second image to show significant signs of alteration was the satellite image showing two Buk missile launchers in fields close to Zaroshchens'ke. The Center's analysis identified signs that the Buk missile launchers did not match the underlying image, suggesting they had been enhanced or added digitally from other images. The Center concludes "we can assess this image to have been so heavily manipulated that it lacks any credibility as evidence" and that "the signs of overt manipulation to this portion of the image renders it totally unreliable as evidence."

The quality of the satellite images that Russia released is poor and appear altered. Therefore, Russia should release the originals to the Joint Investigation Team.

Furthermore, it is impossible for the Ukrainian Buk missile launcher highlighted by the Russian Defence Ministry to travel from its base near Avdiivka to the field where it was supposedly photographed by a satellite on July 17. Bellingcat conducted a crowdfunding campaign in June 2015 to purchase and publish a satellite image from Digital Globe of the Ukrainian anti-aircraft base depicted in the Russian Defence Ministry satellite images.[93] The images, which were taken at 11:08am local time on July 17, 2014 and later uploaded to the Google Earth archives, show a Buk missile launcher parked at the base, as it had been months before, and would continue to be for months after. The Russian Defence Ministry satellite image, supposedly taken at 11:32am on the same day, show that the Buk missile launcher is gone. Therefore, according to the implied Kremlin narrative, the Buk missile launcher left sometime between 11:08am and 11:32am.

[92] http://www.armscontrolwonk.com/archive/1201635/mh17-anniversary/
[93] https://www.bellingcat.com/news/uk-and-europe/2015/06/12/july-17-imagery-mod-comparison/

However, unless the Russian images were fabricated and/or misdated, this is not the case. Another image presented by the Russian Defence Ministry showing presumably this same Buk missile launcher in a field near Zaroshchenske was supposedly taken at 11:32am on July 17, 2014.[94]

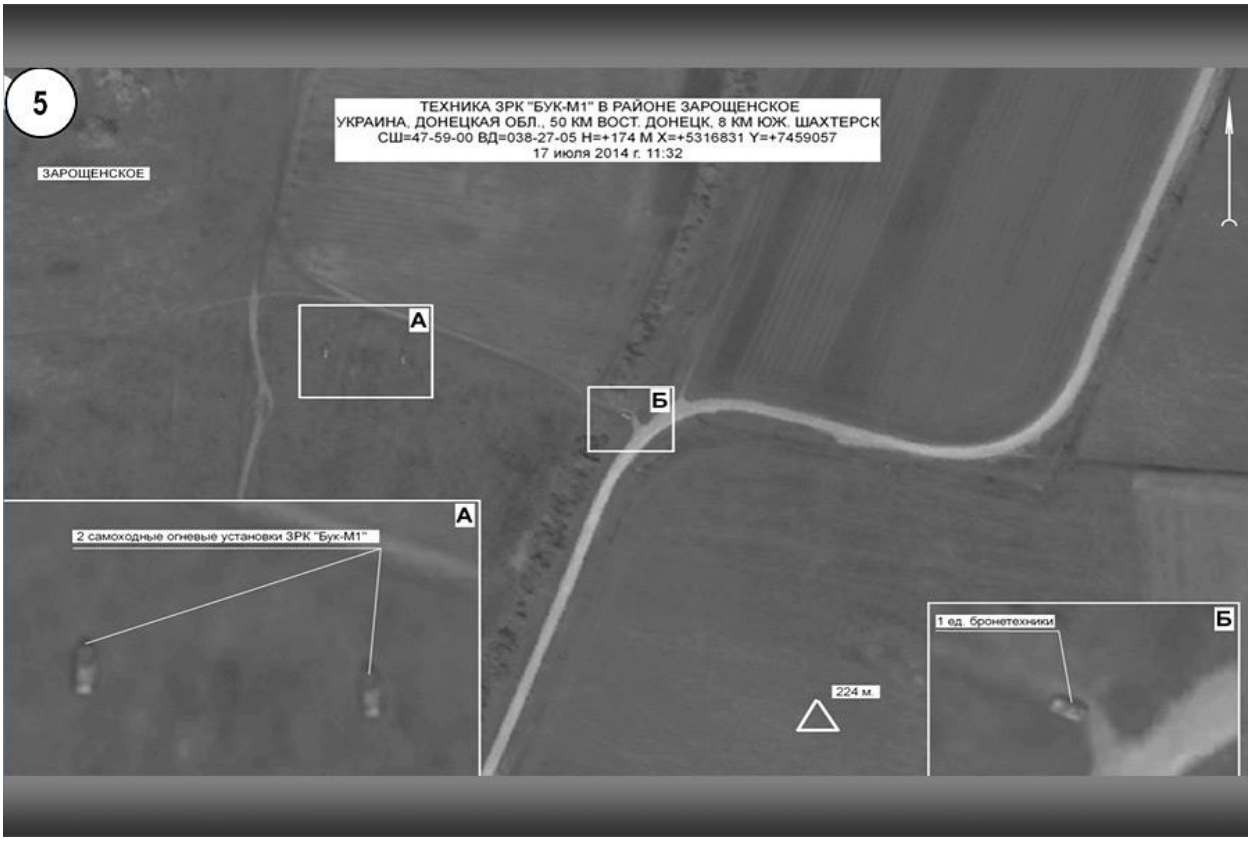


Figure 42: Russian Defence Ministry satellite images from July 17 2014 claiming to show two Buk missile launchers near Zaroshchenske

The Avdiivka base and the field in Zaroshchenske are 53 kilometers apart as the bird flies, not even considering the roundabout route that the Ukrainian military would need to take around separatist-held territory. Even in the absolute best conditions, without any traffic, military checkpoints, or logistical concerns of loading or unloading a large piece of military equipment, it is physically impossible for a Buk missile launcher to travel between these two points within 24 minutes. In short: the Russian Defence Ministry fabricated and purposefully misdated satellite images of the Ukrainian anti-aircraft base and a field near Zaroshchenske in an attempt to create a narrative of a particular Ukrainian Buk missile launcher being deployed shortly before the MH17 shoot down.

[94] http://stat.multimedia.mil.ru/images/military/military/photo/mh17_brief_06-900.jpg

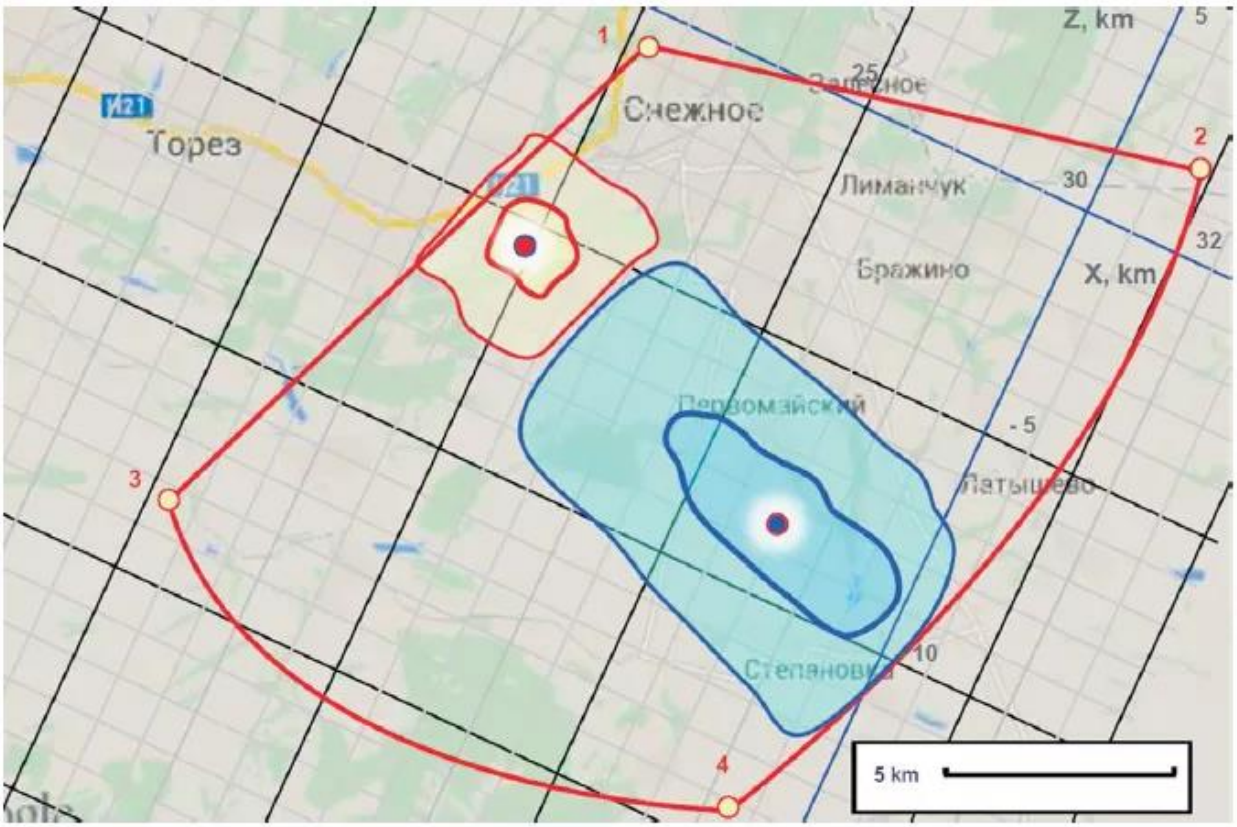


Figure 64: Visualisation of JSC Concern Almaz-Antey fly out simulation results. Note: The red line, numbered 1 to 4, marks the initial area identified by the NLR fly out simulation; an area since updated. (Source: JSC Concern Almaz-Antey)

Figure 43: Diagram of proposed launch locations from the Dutch Safety Board

In addition to these clear attempts to deceive, the Dutch Safety Board's analysis for both the 9M38M1 Buk missile, which was initially identified as the correct missile by Almaz-Antey, and 9M38 missile, which was identified by Almaz-Antey in its second press conference, point to an area near Snizhne as the correct launch site.

These launch sites are far to the east of Zaroshchenske. Additionally, even if these factors are disregarded, there is a much more fundamental fact that the Russian Defence Ministry was not aware of: the Buk missile launcher that they tried to suggest downed MH17 was not functional, and did not move an inch for months.[95]

In sum, the overlapping counter-narratives of the Russian Defence Ministry and Almaz-Antey regarding a Ukrainian Buk and a launch site near Zaroshchenske are nonsensical when considering both direct and circumstantial evidence. From the start, the launch site itself was not controlled by Ukrainian forces on the day of the tragedy, and there are no traces of a

[95] http://ukraineatwar.blogspot.com/2014/10/ukraine-destroyed-buks-that-were-at.html

missile launch in either witness accounts or satellite evidence. Additionally, the Dutch Safety Board's calculations regarding the launch site conclusively point to a location south of Snizhne, not the distant Zaroshchenske. What's more, the primary evidence presented by the Russian Defence Ministry four days after the tragic downing was purposefully misdated and heavily edited.

All in all, there is no reliable evidence indicating that a Buk missile launcher commanded by the Ukrainian military, let alone one from the anti-aircraft base near Avdiivka highlighted by the Russian Defence Ministry, was responsible for the downing of MH17.

Further reading:

- Bellingcat: Zaroshchens'ke Launch Site: Claims and Reality
- Bellingcat: Zaroshchens'ke Revisited: Almaz-Antey's New Launch Areas
- Bellingcat: Buk Launch Site Data in the Dutch Safety Board's MH17 Investigation
- Bellingcat: Quantum of Obfuscation
- *Correct!v*: Flight MH17 – Searching for the Truth

The Russian Ministry of Foreign Affairs

On April 6, 2016 Russian Foreign Ministry spokesperson Maria Zakharova made a statement about the work of Bellingcat, containing the allegation that "acting jointly with the current Ukrainian authorities, they [Bellingcat] continue to use all possible 'fakes,' to create quasi-evidence to blame Russia."[96]

Bellingcat contacted the Russian Ministry of Foreign Affairs, asking for clarification of this statement, and their evidence this statement was true. The Russian Ministry of Foreign Affairs responded, stating "when she mentioned a group cooperating with the current Ukrainian Authorities, Maria Zakharova did not refer to Bellingcat, but to the Joint Investigation Team investigating the MH17 tragedy in the skies over Ukraine."

Bellingcat responded, asking the Russian Ministry of Foreign Affairs to clarify they were in fact accusing the criminal investigation into the downing of MH17 of working with the Ukrainian authorities and using all possible fakes to create quasi-evidence. In response the Russian Ministry of Foreign Affairs didn't answer the question, and instead sent a document with various attacks on Bellingcat's work and the open source evidence.[97]

However, it quickly became apparent that the Russian Ministry of Foreign Affairs had plagiarized the criticism in the document from a popular pro-Putin blog,[98] in some cases copying entire paragraphs from the original source while at no point indicating it had come from any other source but the Russian Ministry of Foreign Affairs. When this was highlighted in Bellingcat's reply the Russian Ministry of Foreign Affairs responded by asking Bellingcat not to email them anymore.[99]

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96 https://www.bellingcat.com/resources/articles/2016/04/14/response-from-the-russian-ministry-of-foreign-affairs-to-bellingcat-regarding-fakery-allegations/

97 https://www.bellingcat.com/resources/articles/2016/04/22/the-russian-ministry-of-foreign-affairs-presents-its-evidence-of-mh17-fakery/

98 https://www.bellingcat.com/news/uk-and-europe/2016/04/22/mfa-plagiarism/

99 https://www.facebook.com/bellingcat/posts/528000750721714

Further reading:

- Bellingcat: Russian Ministry of Foreign Affairs Plagiarized LiveJournal Posts in MH17 Response
- Bellingcat: Response from the Russian Ministry of Foreign Affairs to Bellingcat Regarding Fakery Allegations

Conclusion

Based on online open source investigation we believe the following events occurred:

- Between June 23-25, 2014 the 53rd Anti-Aircraft Missile Brigade transported vehicles within Russia to positions close to the Russian border with Ukraine. This includes Buk 332, later sighted in Ukraine on July 17 and 18, 2014.
- On July 17, 2014 Buk 332 left Donetsk in the morning loaded onto a low-loader, travelling eastwards through separatist-held territory, until it reached the town of Snizhe in the early afternoon.
- After arriving in Snizhne, Buk 332 was unloaded and drove under its own power southward, out of the town.
- Buk 332 arrived at a field south of Snizhne and fired a missile that resulted in the destruction of Flight MH17.
- Buk 332 was next filmed travelling east through the separatist-controlled city of Luhansk on the morning of July 18, 2014.
- On July 21, 2014 the Russian Defence Ministry presented a series of false and fake information. This presentation included lies about the flight path of MH17, about radar data, about the location of the July 18, 2014 Luhansk video, and misdated and heavily edited satellite imagery.
- Almaz-Antey presented data that was not reflected by witness statements on the ground, or any open source information.
- The Russian Ministry of Foreign Affairs was only able to present plagiarized blog posts when asked to present their evidence on the fate of MH17.

To summarize, it is our opinion the Buk missile launcher that shot down MH17 originated in Russia, and the Russian government has lied, faked evidence, and plagiarized blog posts in attempt to place blame elsewhere.

Acknowledgments

We would like to thank all of the experts who provided commentary and analysis for this report. Additionally, we would like to thank all who have provided their insight and findings regarding the open source evidence surrounding the downing of MH17 via Twitter, CheckDesk, the Bellingcat comments page, and other sources.

This report was written and edited by the Bellingcat Investigation Team.