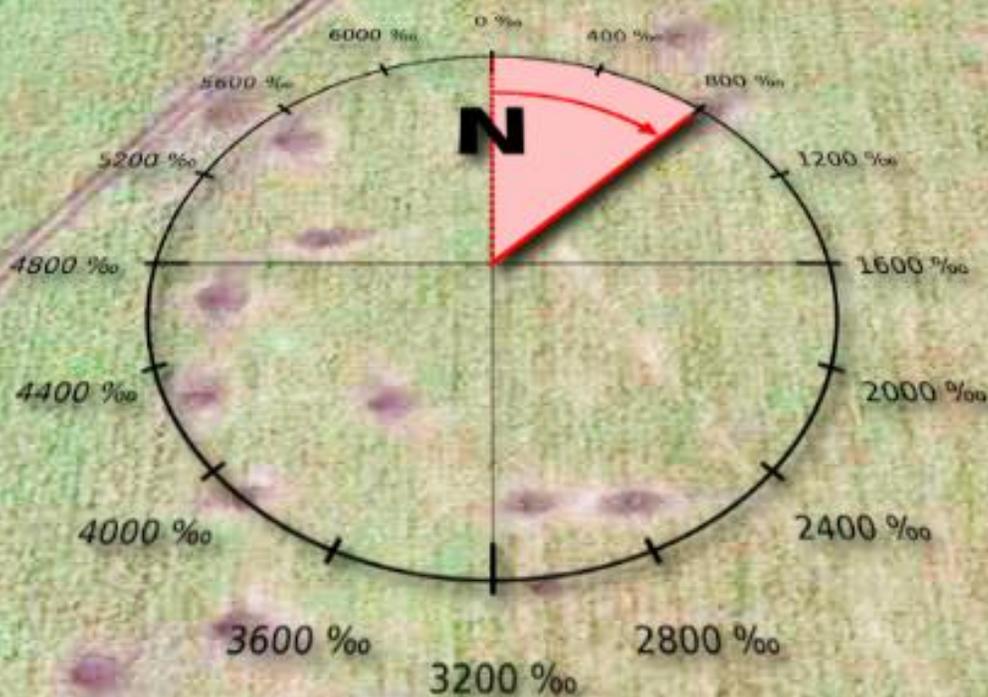


# Origin of Artillery Attacks on Ukrainian Military Positions in Eastern Ukraine between 14 July 2014 and 8 August 2014

A bellngcat Investigation



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## Summary

Ukrainian armed forces positioned near the Russian-Ukrainian border were attacked by artillery fire in the summer of 2014. Between 9 July and 5 September 2014, the Ukrainian Border Service and the National Security and Defense Council reported more than 120 artillery attacks from Russia. Russian officials, however, have denied the existence of any artillery attacks on Ukraine originating from its territory.

The pressure of sustained artillery attacks through early August led Ukrainian armed forces to lose control of hundreds of kilometers of border territory<sup>1</sup>. Google Earth satellite images of eastern Ukraine from July, August, and September 2014 have enabled the Bellingcat investigation team to find evidence of these artillery attacks, determine their origin, and compare them with local sources.

After reviewing and analyzing these satellite images as well as videos from social media, local media reports, and the shifting maps of the ongoing conflict, the Bellingcat investigation team has determined that there is compelling evidence that artillery attacks on Ukrainian territory and against Ukrainian armed forces originated from the territory of Russia.

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<sup>1</sup> <http://russian.rt.com/article/43677#ixzz39JNVe6AU>;  
<http://web.archive.org/web/20150210142502/http://russian.rt.com/article/43677>

# Introduction

In July 2014, Ukrainian armed forces launched an “anti-terrorist operation” against pro-Russian separatists and made significant territorial gains in eastern Ukraine, regaining control over a large portion of the Russian-Ukrainian border.



The situation in the eastern regions of Ukraine on 11 July 2014. Image courtesy of the National Security and Defense Council of Ukraine<sup>2</sup>.

However, on the morning of 11 July 2014, the situation suddenly changed. A massive and unexpected artillery attack on units in the Zelenopillya region killed 30 and wounded over 100 soldiers<sup>3</sup>. In the days and weeks that followed, the units at the border were subjected to

<sup>2</sup> [http://www.rnbo.gov.ua/files/2014/RNBO\\_map\\_11\\_07\\_eng.jpg](http://www.rnbo.gov.ua/files/2014/RNBO_map_11_07_eng.jpg);  
[http://web.archive.org/web/20150210142635/http://www.rnbo.gov.ua/files/2014/RNBO\\_map\\_11\\_07\\_eng.jpg](http://web.archive.org/web/20150210142635/http://www.rnbo.gov.ua/files/2014/RNBO_map_11_07_eng.jpg)

<sup>3</sup> <http://www.interpretermag.com/ukraine-liveblog-day-144-30-ukrainian-soldiers-killed-near-russias-border/>;

dozens of additional artillery attacks. By late July 2014, the massive bombardment reversed Ukrainian gains and contributed to the encirclement of portions of the Ukrainian armed forces. A separatist offensive across eastern Ukraine began simultaneously with the artillery attacks, leading to the separatists capturing much of the Russian-Ukrainian border along with vast areas of the Donetsk and Lugansk oblasts.

Artillery attacks on Ukrainian forces near the border proved to be an important factor in turning the conflict in favor of the separatists. Using in-depth analysis of satellite imagery and social media sources, this Bellingcat investigation brings new evidence to help clarify to the origins of these artillery attacks against Ukrainian armed forces.

## Research methods and sources

The starting point for this Bellingcat investigation was the distribution of updated satellite imagery from Google (DigitalGlobe satellite imagery) with a panchromatic resolution of 0.5m from the territory of eastern Ukraine and its border regions with Russia (17 July to 31 August 2014 satellite images). Additionally, the Bellingcat investigation team analyzed videos shared on social media (YouTube and VKontakte) and geolocated the events captured in these videos to key sites involved in the artillery attacks on Ukraine.

From the satellite imagery, the Bellingcat investigation team located artillery impact crater fields from artillery fire and conducted extensive analysis on a crater-by-crater basis. In the examination of each area, our team created a novel analysis method based on internationally-recognized 'on-the-ground' procedures to determine the trajectory of the artillery fire.

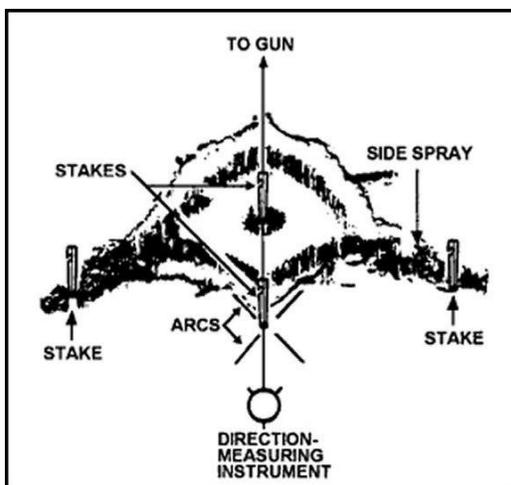


Figure J-3 side-spray method<sup>4</sup>

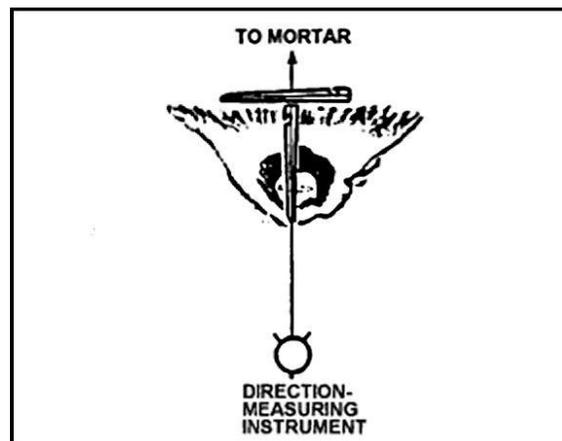


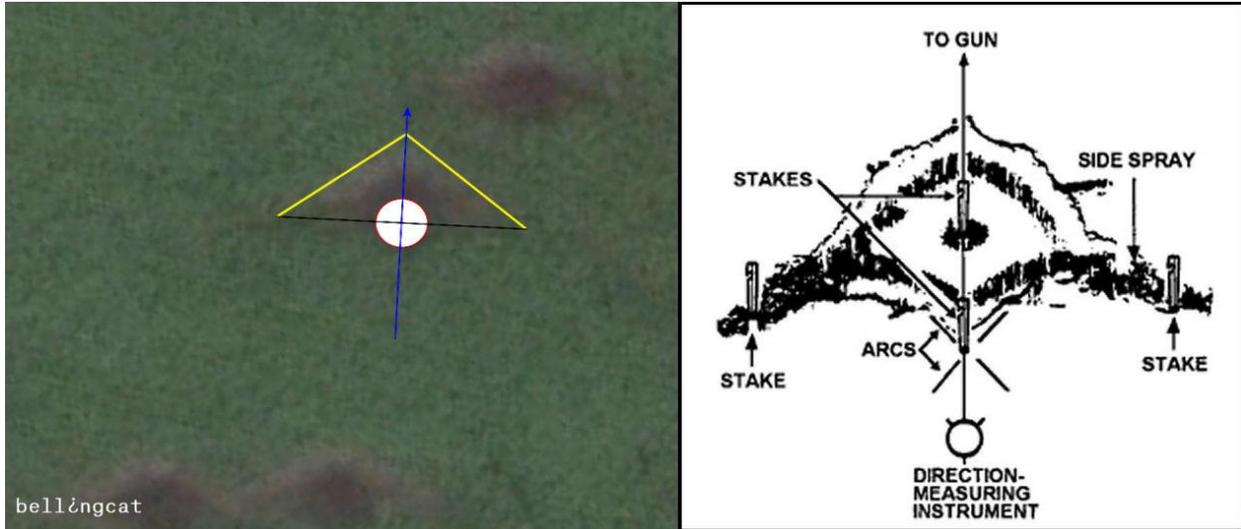
Figure J-6 splinter groove method<sup>5</sup>

<http://web.archive.org/web/20140711204743/http://www.interpretermag.com/ukraine-liveblog-day-144-30-ukrainian-soldiers-killed-near-russias-border/>

<sup>4</sup> [http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm#fig\\_3](http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm#fig_3)

<http://web.archive.org/web/20020215215239/http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm>

The satellite images from eastern Ukraine show two main types of craters, low-angle fuze quick craters (with distinctive 'side spray' areas projecting diagonally from a central crater) and high-angle shell craters (triangular-shaped craters that spread outwards towards the origin of fire):



Low-angle fuze quick craters (e.g. low-angle artillery or Multiple Launcher Rocket Systems fire)



High-angle shell craters (e.g. mortars, high-angle Multiple Launcher Rocket Systems fire)

Both types of craters are suitable for determining the trajectory of artillery fire. In reality, the trajectory of the projectile is determined by a variety of factors, such as the type and hardness of the ground struck, wind direction and speed, and the type of projectile. Our team adopted a simple linear trajectory in our analysis, but the actual trajectory may vary somewhat due to these factors.

<sup>5</sup> [http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm#figj\\_6](http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm#figj_6);  
<http://web.archive.org/web/20020215215239/http://www.globalsecurity.org/military/library/policy/army/fm/6-50/Appj.htm>

## The Amvrosiivka attack 14 July 2014

In a 14 July 2014 summary of the “anti-terrorist operation,” Ukrainian media reported that an attack took place on positions of the Ukrainian armed forces in the vicinity of Amvrosiivka<sup>6</sup>. It was suspected that the origin of this attack was from the territory of Russia<sup>7</sup>.

On the satellite image below, taken on 16 July 2014, an extensive crater field south of Amvrosiivka is visible, located at the coordinates 47°45'52.38"N 38°30'47.65"E.



The crater field near Amvrosiivka from the 14 July 2014 attack, positioned at 47°46'1.07" N 38°30'43.16" E. Google Earth satellite image date 16 July 2014.

The Bellingcat investigation team counted a total of 330 craters in this crater field and determined the observable direction of each impact crater based on the analysis methods previously described. From these 330 craters, the average trajectory was calculated and was determined to be 193.97°, i.e. from the south-south west (180 ° being due south). When screening for possible firing positions from this trajectory, the Bellingcat investigation team found a firing position 14.6km from the crater field. Burn marks are visible at this location, which is on Russian territory and approximately 750m from the border near the Russian village of Seleznev at the coordinates 47°38'13.52"N 38°28'9.69"E.

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<sup>6</sup> <https://en.informnapalm.org/anti-terrorist-operation-summary-for-july-14-2014/>;  
<http://web.archive.org/web/20150210142924/https://en.informnapalm.org/anti-terrorist-operation-summary-for-july-14-2014/>

<sup>7</sup> <https://www.facebook.com/v.parasyuk/posts/675221185878989>

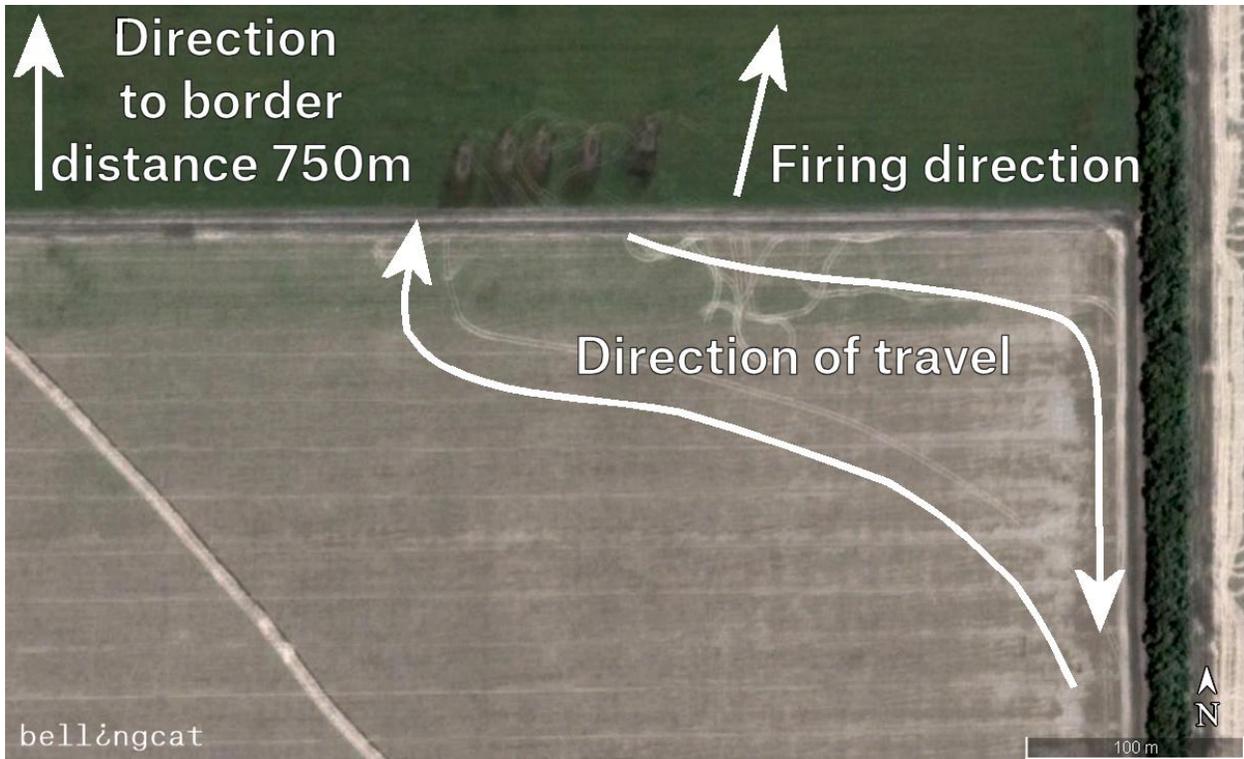


Crater field and firing position, viewing north-north-east

Based on our crater analysis, we judge that these were very likely the five firing sites that caused the craters near Amvrosiivka. There are several pieces of evidence that lead us to believe that these strikes were carried out by five 122mm BM-21 Grad or 9K51M Tornado-G Multiple Rocket Launcher Systems (MLRS) as opposed to the BM-27 Uragan, BM-30 Smerch, or other types of field artillery.

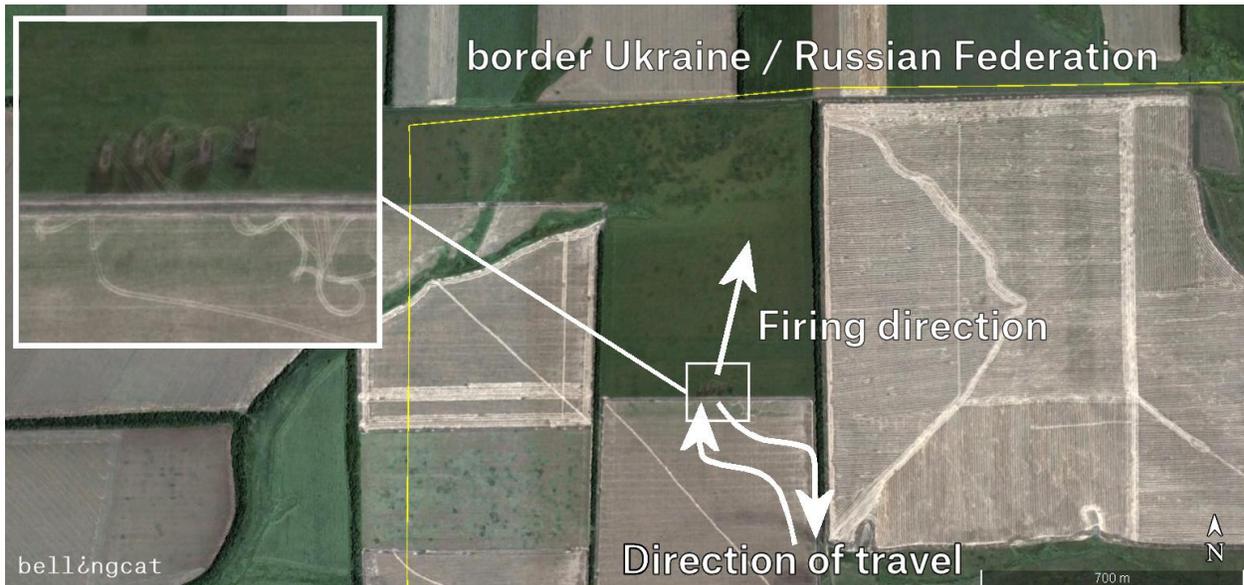
It is well known that BM MLRS create large areas of smoke behind them during and after firing. Many examples of this are available online<sup>8</sup>. This area of intense smoke and heat results in burned/singed ground behind the MLRS and are visible from Google satellite images. Such burned areas are visible at the firing position considered for the Amvrosiivka attack, and so we judge that these were very likely MLRSs.

<sup>8</sup> [https://www.youtube.com/watch?v=ly6\\_2ojur0Q](https://www.youtube.com/watch?v=ly6_2ojur0Q)



Firing position near Seleznev. Position: 47°38'14.38"N, 38°28'9.77"E.  
 Google Earth satellite image date 16 July 2014.

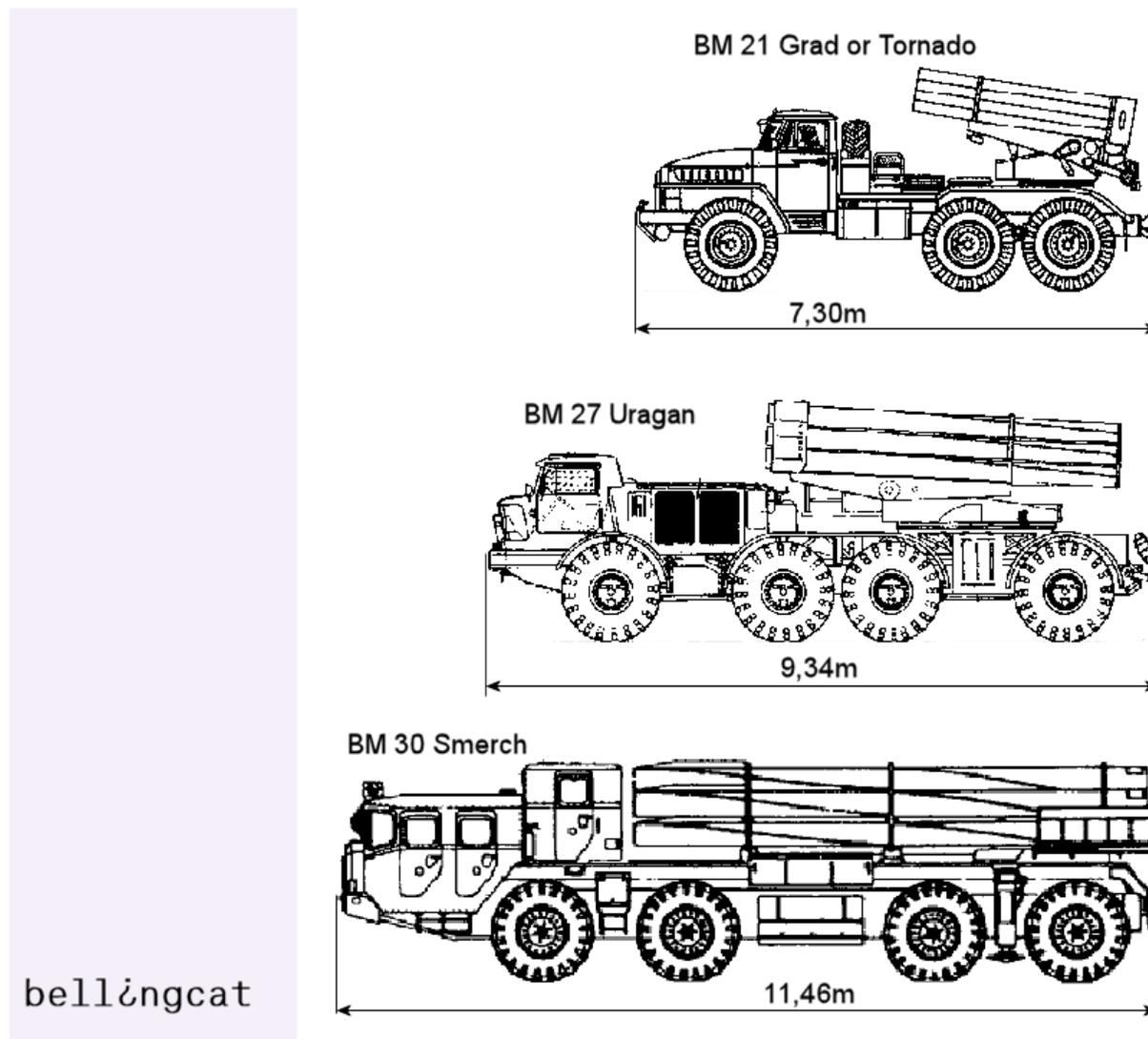
Analyzing the satellite imagery of the firing position also gave us evidence for determining the type of MLRS most likely used to conduct the artillery attack.



The visible tracks that lead to the site come from farther inside Russian territory.

The tracks of the vehicles that entered and exited the field to reach their firing positions are visible from the satellite imagery. This leads us to believe that there was no cross-border (Ukraine to Russia) movement of military equipment for this particular location.

Three MLRS systems are primarily used by the Russian military (see Russian MLRS systems figure below).

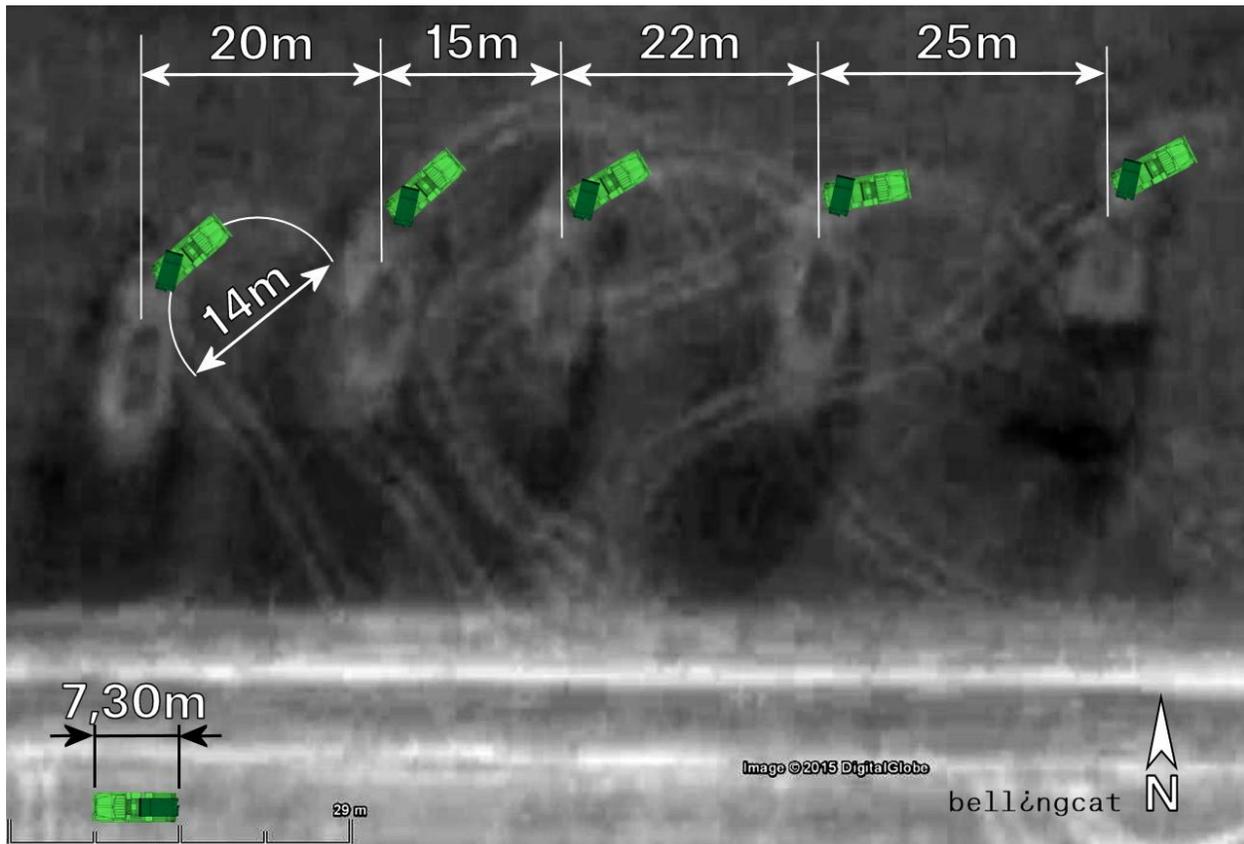


Russian MLRS systems

The measurement of the average track width from the satellite images yielded an average value of 2.40m. As the resolution of the satellite images is 0.5m, the tolerance for this measurement is 1.9 to 2.9m. In comparison, the widths of the BM-21/Tornado-G, BM-27, and BM-30 are 2.4, 2.8, and 3.1m, respectively. The track width determined from satellite imagery is suggestive of a smaller vehicle, but because of the potential error due to imagery resolution, this is not conclusive.

Using the satellite images, we were able to determine the turning radii of the vehicles. The smallest turning radius was measured as 14m. The BM-27 and BM-30 MLRSs have two steered front axles, so if they were used in this instance, we would expect to see evidence of two overlapping sets of wheel tracks in the turns leading to or from the firing position. However, the satellite image shows only the traces of one clear, single track. Based on this

evidence, we conclude with high probability that a BM-21 Grad or 9K51M Tornado-G was used for this attack.



The spacing between, and the sizes of the types of MLRS units judged to be at the firing position

The visible traces of the vehicles also fit well for the typical spacing of BM-21/Tornado-G systems in battle formation (see the image above for the spacing of the units visible from the satellite image). According to Army Field Manual No. 100-2-3,<sup>9</sup>

*The BM-21 launcher can be traversed through 180° and the bank of 40 launcher tubes elevated from 0 to +55° electrically or manually. The rockets can be launched singly at any desired time interval by manual means or in partial or complete salvo at a fixed 0.5-second time interval from within the cab or up to 60 m away from the cab with the aid of a remote-control unit connected to the vehicle by a cable. The rockets must be fired with the launcher parked obliquely to the target to prevent blast damage to the unshielded cab.*

Our investigation of this attack shows that the average trajectory of the craters pointed toward the direction of the suspected firing positions with a high degree of accuracy; the maximum-to-minimum deviation of the analyzed crater angles is only 0.2%. Additionally, a measurement in the other direction, extrapolating the trajectories of the visible burn marks at the firing position, revealed that the trajectories led directly to the center of the artillery crater field.

<sup>9</sup> <https://www.fas.org/irp/doddir/army/fm100-2-3.pdf>

## Artillery attacks in the Chervonopartyzansk region 14 July to 8 August 2014

In early July 2014, units from the 72<sup>nd</sup> Motorized Brigade, the 79<sup>th</sup> Airmobile Brigade, the 24<sup>th</sup> and 51<sup>st</sup> Mechanized Brigades, and elements of the 3<sup>rd</sup> Separate Special Forces Regiment were tasked with securing the Russian-Ukrainian border south of the separatist-held towns from Marynivka to the Izvaryne checkpoint. This area, covering over 150km of border, was known as "Sector D"<sup>10</sup>.

From the end of the ceasefire on 1 July until 11 July, Ukrainian units advanced quickly and found relatively little resistance until they reached the Chervonopartyzansk/Gukovo checkpoint. Then, the situation changed dramatically. The Zelenopillya artillery attack against Ukrainian forces on 11 July was followed by artillery attacks against large conglomerations of Ukrainian units in the area close to the Dolzhanskaya-Capital mine and Panchenkove, Chervonopartyzansk, Khmelnytskyi, Biryukove, Dolzhanskyi border control point and the Dyakove region. As the world diverted their attention on the horror of the Malaysian Airlines Flight 17 (MH17) shoot down on 17 July, the situation sharply deteriorated for the Ukrainian units on the eastern border.

On 22 July, Dmytrivka, a town on the supply road to Sector D, came under attack from separatists<sup>11</sup>. For the next two weeks, transport along the roads east of these towns greatly limited resupply and reinforcement for the trapped units<sup>12,13,14</sup>. From interviews and media reports, it was evident that conditions were dire<sup>15,16</sup>. Despite this, the units on the border continued to hold their positions.

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<sup>10</sup> <http://www.thedailybeast.com/articles/2014/08/12/ukrainian-troops-retreat-from-russian-border-leaving-100-kilometers-defenseless-against-invasion.html>;  
<http://web.archive.org/articles/2014/08/12/ukrainian-troops-retreat-from-russian-border-leaving-100-kilometers-defenseless-against-invasion.html>

<sup>11</sup> <http://uacrisis.org/lysenko2-22-07-2014/>;

<http://web.archive.org/web/20141129002451/http://uacrisis.org/lysenko2-22-07-2014/>

<sup>12</sup> <http://maidantranslations.com/2014/07/24/dmitry-tymchuks-military-blog-summary-july-23-2014/>;

<http://web.archive.org/web/20141206131810/http://maidantranslations.com/2014/07/24/dmitry-tymchuks-military-blog-summary-july-23-2014/>

<sup>13</sup> <http://maidantranslations.com/2014/07/27/towns-in-donbas-have-been-liberated-thanks-to-the-72nd-and-79th-brigades/>;

<http://web.archive.org/web/20141206184958/http://maidantranslations.com/2014/07/27/towns-in-donbas-have-been-liberated-thanks-to-the-72nd-and-79th-brigades/>

<sup>14</sup> <http://mignews.com.ua/sobitiya/inukraine/3342474.html>;

<http://web.archive.org/web/20150210143339/http://mignews.com.ua/sobitiya/inukraine/3342474.html>

<sup>15</sup> <http://mignews.com.ua/sobitiya/inukraine/3363561.html>;

<http://web.archive.org/web/20150210143455/http://mignews.com.ua/sobitiya/inukraine/3363561.html>

<sup>16</sup> <https://www.youtube.com/watch?v=IX6e3wr34BM>

On 3 August, a breakthrough by Ukrainian units in the west unblocked a potential resupply route (between Dyakove and Dmytrivka) to the beleaguered units on the border<sup>17</sup>. That same day, pro-Russian forces sharply increased the number of attacks against the trapped units on the border<sup>18</sup>. Out of ammunition, on 4 August, over 400 Ukrainian soldiers from the 72<sup>nd</sup> Mechanized Brigade fled across the border to escape the constant bombardment<sup>19</sup>. By 8 August, the remainder of the 72<sup>nd</sup> and 79<sup>th</sup> brigades had broken out of the encirclement, and around 1,000 survivors were able to regroup with other units near Savur-Mohyla<sup>20</sup>.

Significant artillery attacks upon Ukrainian units in the border region east of Dmytrivka were undoubtedly a key factor in the retreat of Ukrainian units from Sector D. However, until now, the trajectories and firing positions of the artillery attacks that led to this defeat have not been analyzed. In the following section, we analyze two of the largest visible artillery attacks close to Chervonopartyzansk and Sverdlovsk, where Ukrainian units were hit by hundreds of visible artillery shells during July and August 2014.

### **The Dolzhanskaya-Capital mine/Panchenkove attacks 14 July 2014 to 8 August 2014**

On 14 July 2014, consistent accounts emerged in both Ukrainian and pro-Russian media outlets that clashes took place in the vicinity of a mine called 'Dolzhanskaya-Capital,' close to the Ukrainian town of Panchenkove<sup>21,22</sup>.

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<sup>17</sup> <https://en.informnapalm.org/anti-terrorist-operation-ukraine-summary-august-4-2014/>;  
<http://web.archive.org/web/20150210143548/https://en.informnapalm.org/anti-terrorist-operation-ukraine-summary-august-4-2014/>

<sup>18</sup> <http://euromaidanpress.com/2014/08/05/dmitry-tymchuks-military-blog-summary-august-4-2014/>;  
<http://web.archive.org/web/20141208115423/http://euromaidanpress.com/2014/08/05/dmitry-tymchuks-military-blog-summary-august-4-2014/>

<sup>19</sup> <http://www.bbc.com/news/world-europe-28652096>;  
<http://web.archive.org/web/20141229035005/http://www.bbc.com/news/world-europe-28652096>

<sup>20</sup> <http://www.thedailybeast.com/articles/2014/08/12/ukrainian-troops-retreat-from-russian-border-leaving-100-kilometers-defenseless-against-invasion.html>;  
<http://web.archive.org/articles/2014/08/12/ukrainian-troops-retreat-from-russian-border-leaving-100-kilometers-defenseless-against-invasion.html>

<sup>21</sup> <http://www.dtek.com/ru/media-centre/press-releases/details/v-dtek-sverdlovanratsit-v-rezultate-boevikh-dejstvij-obestocheni-dve-shakhtoplosshadki>;  
<http://web.archive.org/web/20150210143935/http://www.dtek.com/ru/media-centre/press-releases/details/v-dtek-sverdlovanratsit-v-rezultate-boevikh-dejstvij-obestocheni-dve-shakhtoplosshadki#.VNoYQixcpjA>

<sup>22</sup> [http://www.gazeta.ru/social/news/2014/07/16/n\\_6315585.shtml](http://www.gazeta.ru/social/news/2014/07/16/n_6315585.shtml);  
[http://web.archive.org/web/20141025100221/http://www.gazeta.ru/social/news/2014/07/16/n\\_6315585.shtml](http://web.archive.org/web/20141025100221/http://www.gazeta.ru/social/news/2014/07/16/n_6315585.shtml)



Crater fields near Dolzhanskaya-Capital mine

Considerable disruptions to the mine's power system affected pumps and the ventilation system, leading to the evacuation of 278 miners.

The satellite image from 8 August shows the cause of the power outage: large amounts of artillery fire that destroyed several electricity poles in the vicinity of the mine. Analysis of the damaged electricity poles and their connections suggested that only lines leading directly to the mine were affected. Therefore, there was no evidence to suggest that power to nearby towns was disrupted due to this attack.

The Bellingcat investigation team researched media reports from mid-July to confirm attacks from this time period. Official Ukrainian government sources reported artillery attacks on 23 July and 1 August<sup>23</sup>, and Ukrainian media sources also reported attacks in this area on 16 and 24 July, and from 1 to 4 August<sup>24</sup>. The following comparison of maps provided by separatist sources shows the course of the battles in July and August throughout the region and also suggests several specific dates for attacks on Ukrainian forces<sup>25</sup>.

<sup>23</sup> <http://mediarnbo.org/?lang=en>;  
<http://web.archive.org/web/20150209075216/http://mediarnbo.org/?lang=en>

<sup>24</sup> <http://maidantranslations.com/category/opinions/dmitry-tymchuk/>;  
<http://web.archive.org/web/20141201222146/http://maidantranslations.com/category/opinions/dmitry-tymchuk/>

<sup>25</sup> <http://warday.su/map/53-karta-boevyh-deystviy-18-22-iyulya.html>;  
<http://web.archive.org/web/20150210144240/http://warday.su/map/53-karta-boevyh-deystviy-18-22-iyulya.html>



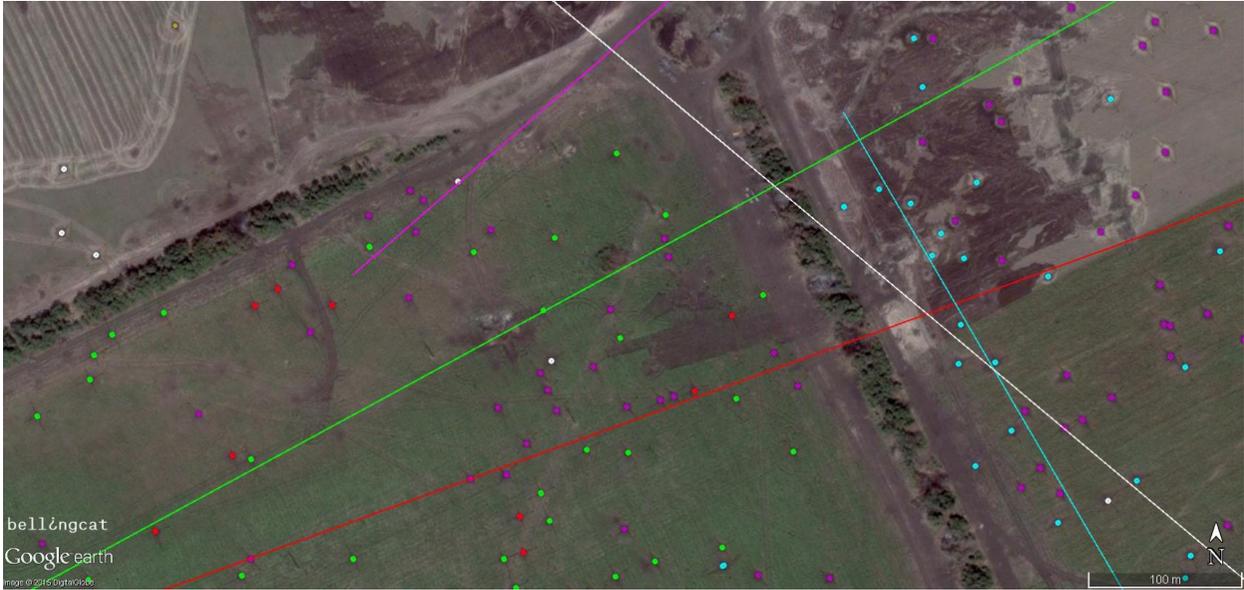
Battles southeast of Sverdlovsk from 11 to 24 July (map from pro-Russian websites)



Battles southeast of Sverdlovsk from mid-July to early August (map from pro-Russian sites)

The Bellingcat investigation team analyzed a number of videos shared on YouTube and VKontakte (VK), Russia's most popular social networking site. From these sources, it was established that at least two attacks occurred on 16 July.

Next, our team analyzed the crater field near the Dolzhanskaya-Capital mine outside of the Panchenkove village by using satellite imagery from 8 August 2014. A total of 813 craters were measured.



Crater fields near the Dolzhanskaya-Capital mine

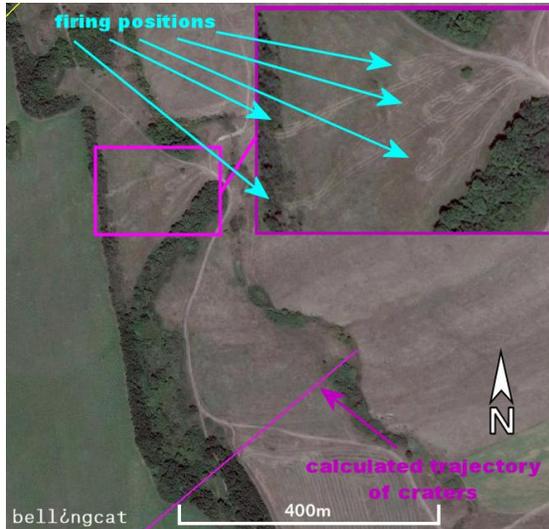
Analysis of the calculated trajectories in the crater field reveals that there were six separate attacks from five different directions.



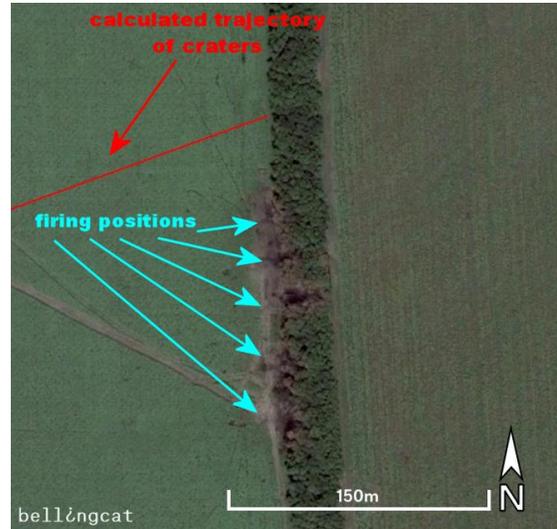
Crater fields near the Dolzhanskaya-Capital mine showing six separate firing trajectories. With maximum differences of 300m at a shelling distance of 15km, all of the calculated trajectories can be traced to five separate firing positions. Every one of these – with the exception of the position near Chervonopartyzansk, Ukraine, which is close to the border – is clearly within the territory of Russia.

The firing positions, from north to south, were located in the following positions:

1. Near Nizhnyaya Kovalevka, Russia at  $48^{\circ}07'51.4''\text{N}$ ,  $39^{\circ}54'02.4''\text{E}$
2. Near Chervonopartyzansk, Ukraine at  $48^{\circ}03'03.2''\text{N}$ ,  $39^{\circ}49'52.2''\text{E}$

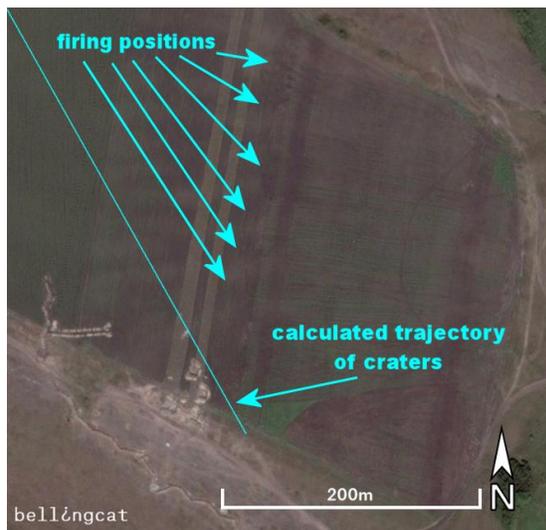


Firing position near Nizhnyaya Kovalevka, Russia

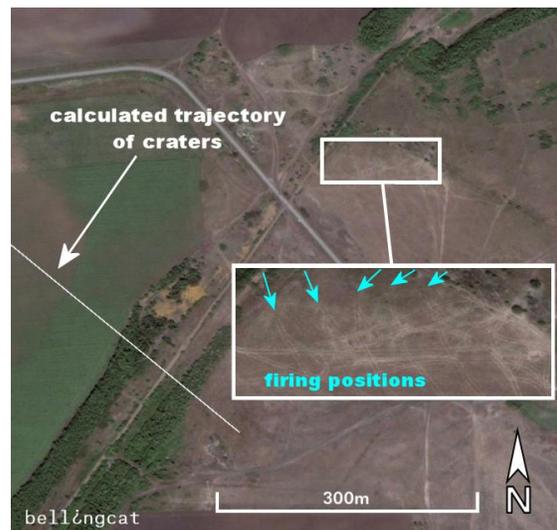


Firing position near Chervonopartyzansk, Ukraine

3. Near Pavlovka, Russia at  $47^{\circ}56'28.1''\text{N}$ ,  $39^{\circ}49'12.0''\text{E}$
4. Near Ukrainskiy, Russia at  $47^{\circ}58'23.0''\text{N}$ ,  $39^{\circ}51'01.5''\text{E}$



Firing position near Pavlovka, Russia

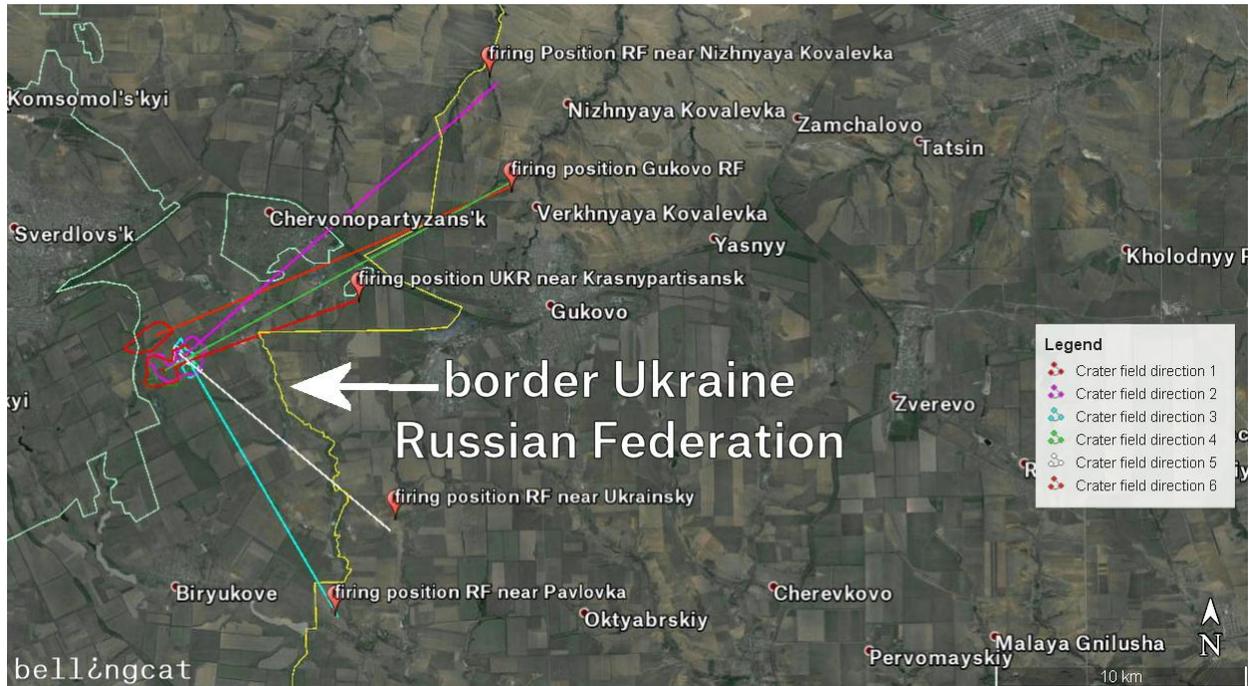


Firing position near Ukrainskiy, Russia

The one exception was a firing position located near Chervonopartyzansk, within the territory of Ukraine.

5. Near Gukovo, Russia at  $48^{\circ}05'25.0''\text{N}$   $39^{\circ}54'45.3''\text{E}$

The firing position near Gukovo is particularly noteworthy, because numerous videos have been shared on social media showing artillery fire. The firing position shown in these videos will be examined separately in the following section.



Crater fields near the Dolzhanskaya-Capital mine – located firing positions

The Bellingcat investigation team has also found that at all of the firing positions except one (Chervonopartyzansk), vehicle tracks show both an arrival from and departure to areas within Russia. In other words, in four out of five cases, there were no observable tracks linking the firing positions to Ukrainian territory, and all the observable tracks near the firing sites were exclusively within the territory of Russia.

## The firing position near Gukovo

On 17 July 2014, a series of videos were shared on YouTube and VK showing an attack with MLRSs. The attack occurred on 16 July in the vicinity of Gukovo, Russia. This attack has already been geolocated by a number of blogs and articles, for example by The Interpreter<sup>26</sup>.

The Bellingcat investigation team has found six videos on social networks that show the events of 16 July near Gukovo. Two of these videos were captured from the edge of the Kovalevsky pond on the afternoon of 16 July.



Video001

**г. Гуково (РФ), град бьет по Украине**

“City of Gukovo (RF), a Grad strikes at Ukraine”  
added 16 July 2014

Camera location: [48°4'30.76"N 39°55'36.94"E](https://www.youtube.com/watch?v=nuar9RkYCR)

<https://www.youtube.com/watch?v=nuar9RkYCR>  
[A](#)

Alternative link:

<https://www.youtube.com/watch?v=6SIDxVxdIjw>

Video001 shows several MLRS salvos west of the pond. This video has been successfully geolocated a number of times by various journalists, bloggers, and open source investigators<sup>27</sup>.



Video002

**Обстрел ГРАДами территории Украины. г. Гуково, Ростовская область.**

“Bombardment of the territory of Ukraine with Grads, city of Gukovo, Rostov oblast”

16.07.2014, 17.05 (MSK)

added 16 July 2014

Camera location: [48° 4'15.08"N 39°55'24.16"E](https://www.youtube.com/watch?v=GC_pCuqmOm0)

[https://www.youtube.com/watch?v=GC\\_pCuqmOm0](https://www.youtube.com/watch?v=GC_pCuqmOm0)

Alternative link:

<https://www.youtube.com/watch?v=zRCjUPa7qHU>

Video002 shows burning fields northwest of the same pond that appears in Video001. It was suspected at the time that this fire came from MLRS launchers<sup>28</sup>.

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<sup>26</sup> <http://www.interpretermag.com/ukraine-liveblog-day-149-russian-tanks-and-artillery-reach-donetsk/>;

<http://web.archive.org/web/20150108053731/http://www.interpretermag.com/ukraine-liveblog-day-149-russian-tanks-and-artillery-reach-donetsk/>

<sup>27</sup> <http://ukraineatwar.blogspot.dk/2014/07/russian-Grad-firing-from-russian-soil.html>;

<http://web.archive.org/web/20150115124112/http://ukraineatwar.blogspot.nl/2014/07/russian-grad-firing-from-russian-soil.html>

Other Grad rocket volleys were documented in four other videos on the same day in the evening. Each of these videos was captured exactly at sunset, leading to our determination that the videos were captured at approximately 19:15 (MSK, local time)<sup>29</sup>.

An important feature of this collection of videos is that each was captured from different angles facing the firing position. The Bellingcat investigation team was able to precisely determine the location of the firing position from the exact locations of the cameras and the angle and positions of the Grad launchers in each video.



Video003

**Град в Гуково**

“Grad in Gukovo”

added 16 July 2014

Camera location: [48°03'59.0"N 39°55'36.2"E](https://www.youtube.com/watch?v=XUUzNnGGbSk)

<https://www.youtube.com/watch?v=XUUzNnGGbSk>

Alternative Link:

[https://www.youtube.com/watch?v=edE\\_FshuF2U](https://www.youtube.com/watch?v=edE_FshuF2U)

Video003 was captured from a cherry tree on a residential plot on Bazarnaya Street 84 in Gukovo. The identifying features of this video include buildings in the center of the video, the cherry tree as camera location, and the angle and distance from the firing position.



Camera location Video003 – yellow-green lines in the middle point toward the firing position

<sup>28</sup> <http://www.interpretermag.com/ukraine-liveblog-day-149-russian-tanks-and-artillery-reach-donetsk/>;

<http://web.archive.org/web/20150108053731/http://www.interpretermag.com/ukraine-liveblog-day-149-russian-tanks-and-artillery-reach-donetsk/>

<sup>29</sup> <http://suncalc.net/#/48.05.39.9333,13/2014.07.16/19:15>

Video004

**Залп российских ГРАДов из Гукovo в сторону Украины**

"Salvo of Russian Grads from Gukovo in the direction of Ukraine"

added 16 July 2014

Camera location: [48° 4'29.80"N 39°55'36.07"E](https://www.youtube.com/watch?v=8pu0h2O7Rn)  
<https://www.youtube.com/watch?v=8pu0h2O7Rn>

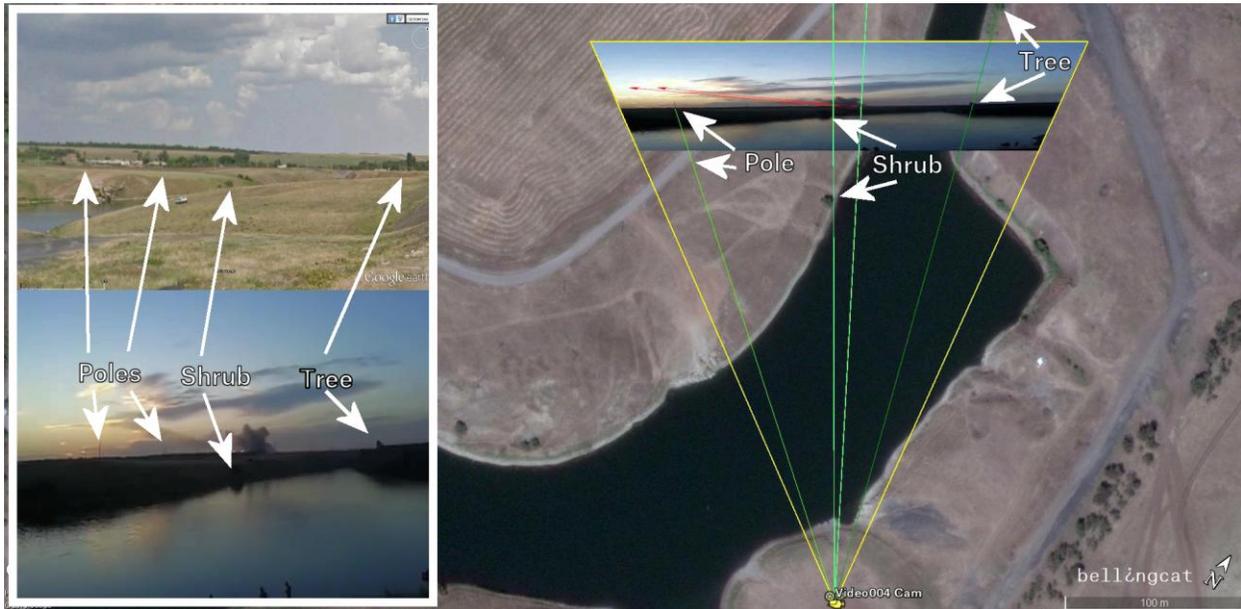
↓

Alternative link:

<https://www.youtube.com/watch?v=8F9WFkA9C08>



Video004 shows the firing position on the southwest side of Kovalevsky pond. The identifying landscape features in this video are the solitary tree on the right side of the camera's perspective, the big bush in roughly the middle of the perspective, and the utility poles on the far left side of the perspective.



Camera location of Video004 – light green lines in the middle point toward the firing position



Video005

Град Гуково, Ростовской обл., Россия по Украине  
Russian attacked Ukraine from Gukovo, Rostov  
Oblast

added 16 July 2014

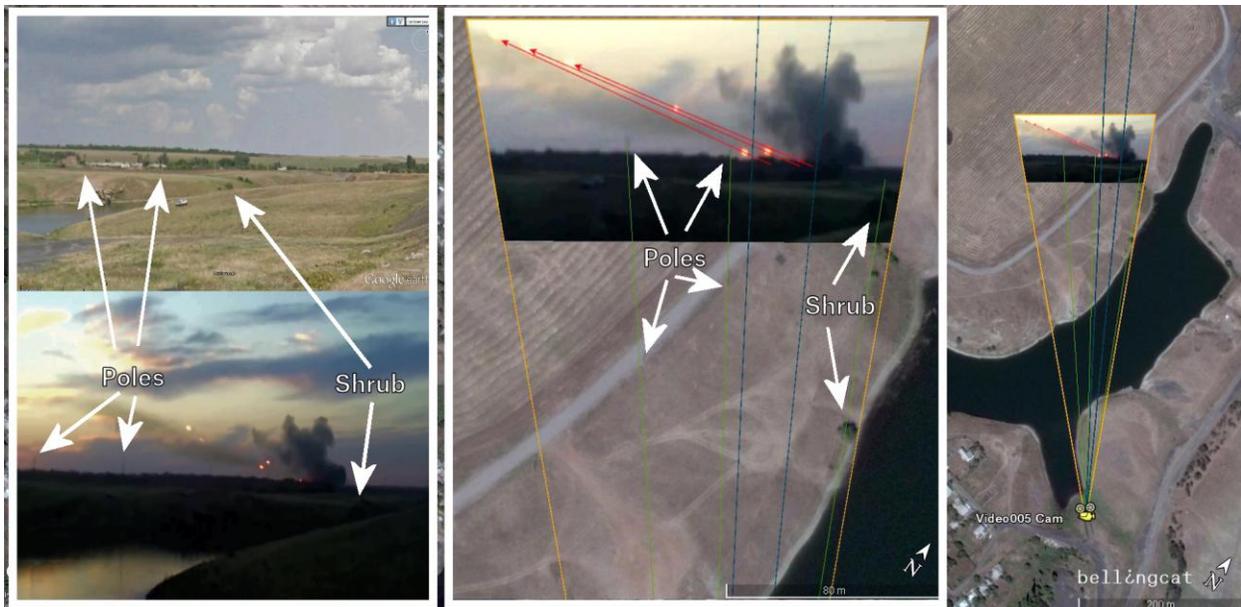
Camera location: [48° 4'24.30"N 39°55'37.12"E](https://www.youtube.com/watch?v=kXpCTUjWGkE)

<https://www.youtube.com/watch?v=kXpCTUjWGkE>

Alternative link:

<https://www.youtube.com/watch?v=6ufW8UxbkPM>

The firing position in Video005 is visible from the southwest side of Kovalevsky pond. The identifying landscape features in this video are the same as Video004: a big bush and utility poles.



Camera location of Video005 – blue lines in the middle point toward the firing position



Video006

Обстрел территории Украины из Гуково, россия

"Shelling of the territory of Ukraine from Gukovo, Russia"

Added 16 July 2014

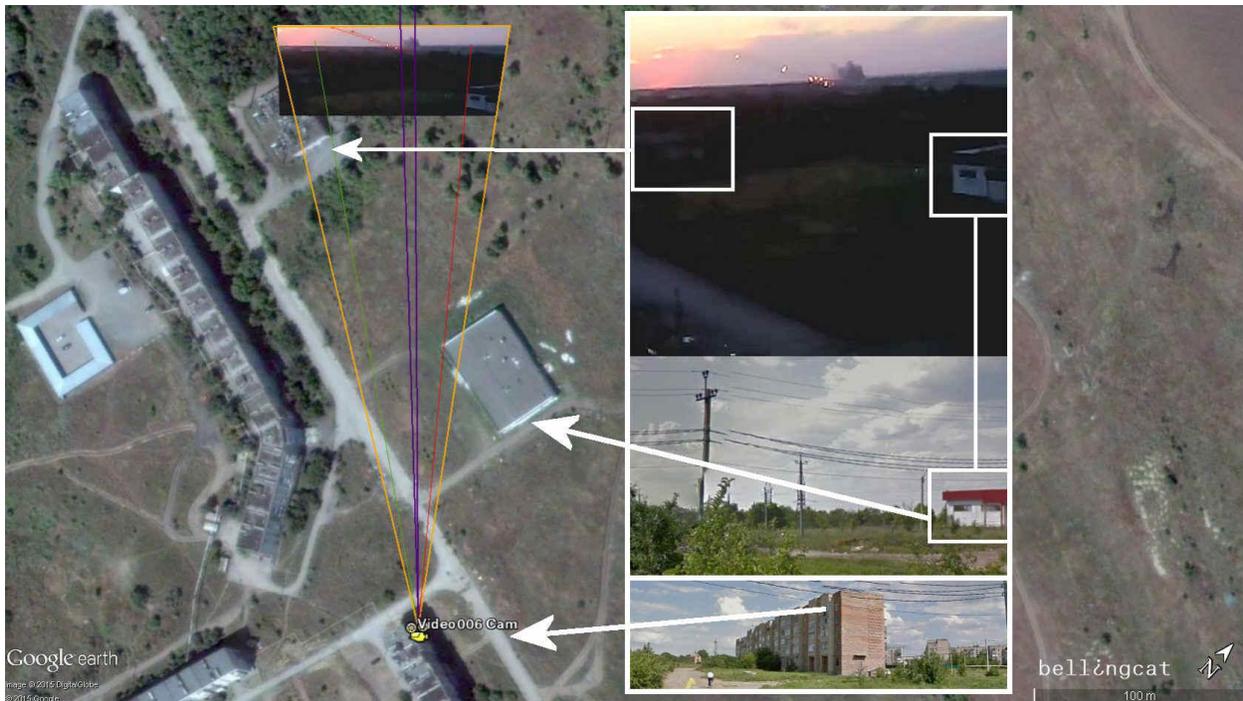
Camera location: [48° 3'33.15"N 39°57'22.60"E](https://www.google.com/maps/place/48+33.15+N+39+57.22+E)

[http://vk.com/video-38854900\\_169727129](http://vk.com/video-38854900_169727129)

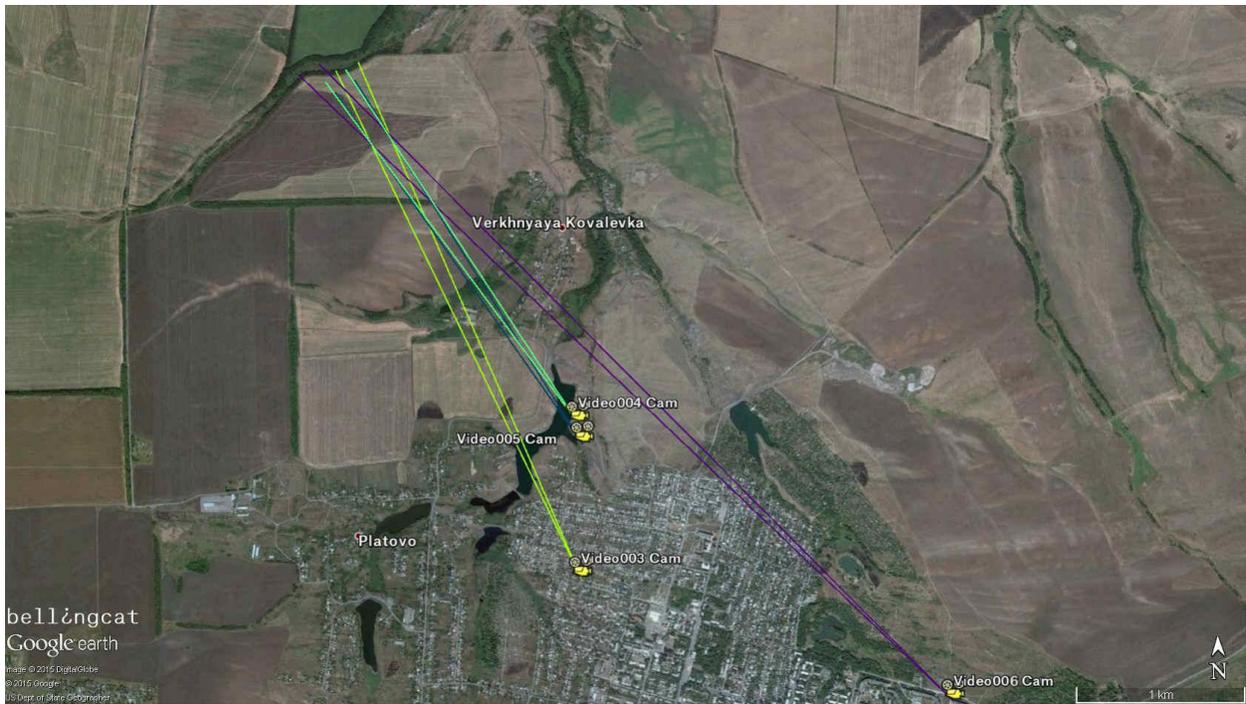
Alternative link:

<https://www.youtube.com/watch?v=TsmcdunSOLA>

Video006 was captured from a residential building on Botanicheskaya Street 7a in Gukovo. The identifying features of this video include a building on the right side of the video, another building on the left side, the road below, and the angle and distance from the firing position.

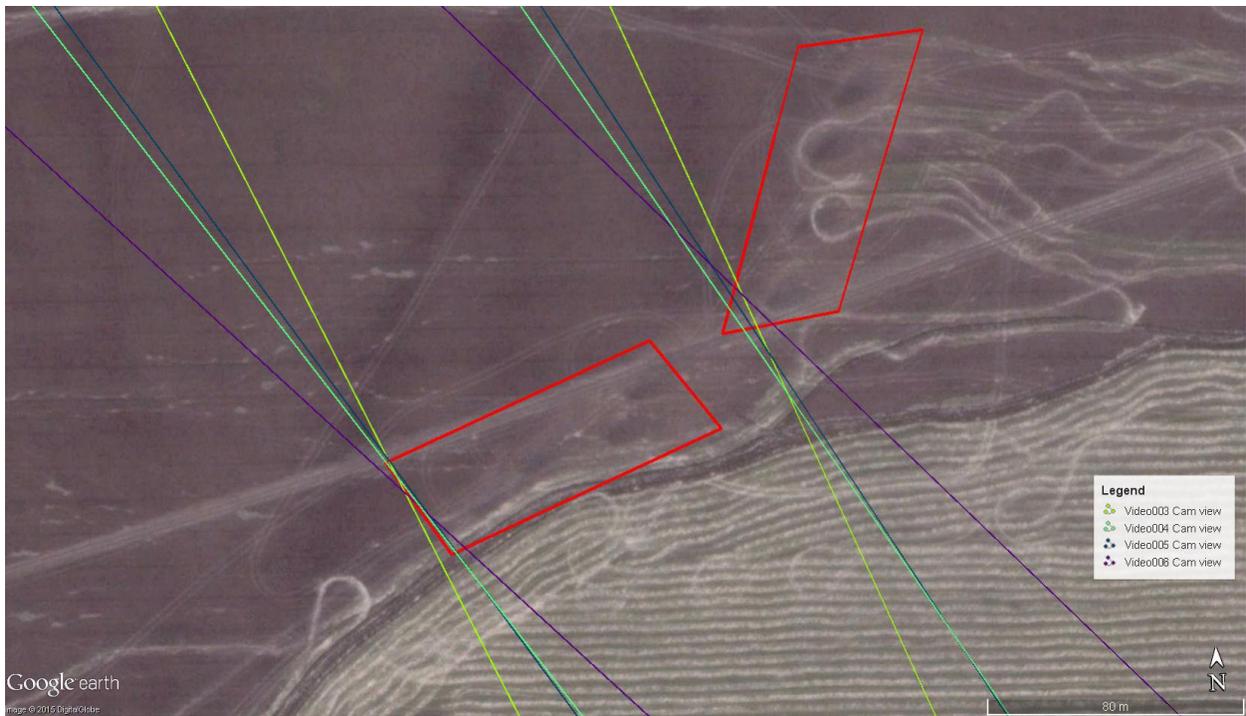


Camera location of Video006 – dark purple lines show the direction of the firing position



The intersections of the viewing directions to the firing position give the exact location

On the satellite image below, taken 8 August 2014, the intersection of the lines clearly shows two visible burns, marking the firing position.



The intersection of viewing directions and the location of Grad firing positions

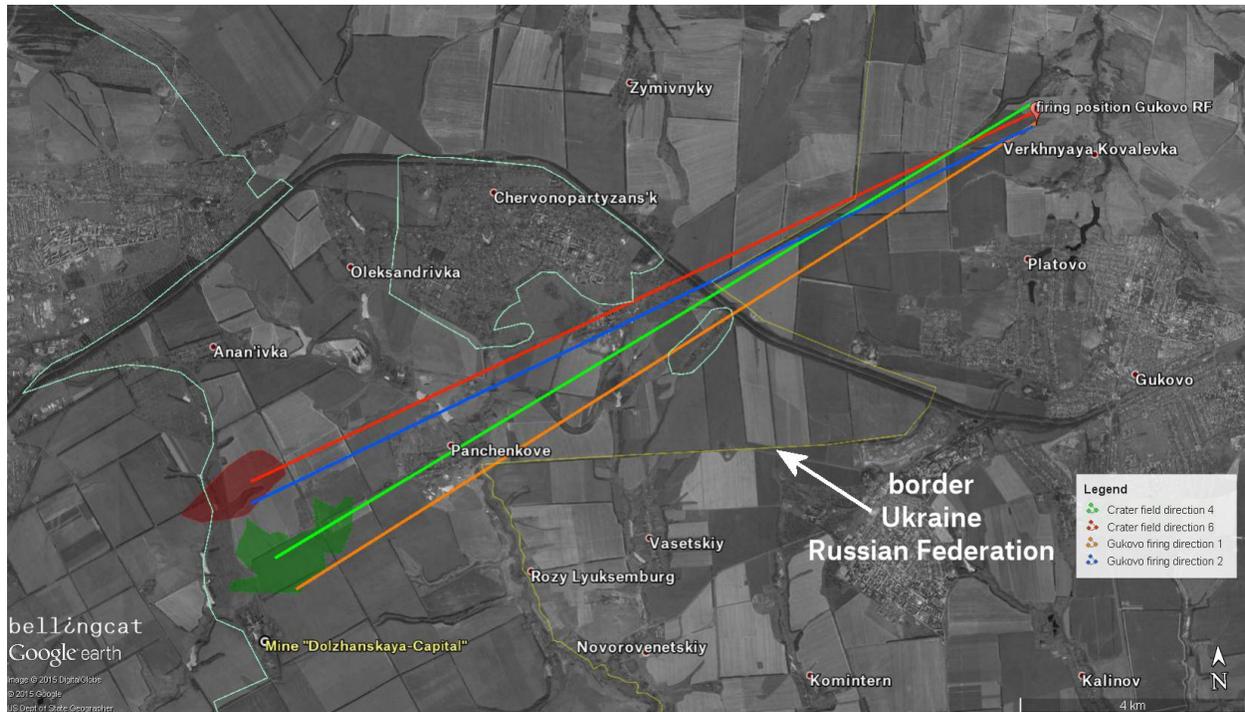
The positions of the cameras in the previous videos clearly point to a firing position north of Platovo. These firing positions are visible from satellite imagery of the burned fields (image above).

As evident from the satellite imagery, there are two visible firing positions for four Grad MLRSs at 48°05'25.0"N 39°54'45.3"E. The Bellingcat investigation team has measured the direction of the traces of fire and calculated the trajectory for each firing position.



Trajectories analyzed from the direction of the burn marks

The calculated trajectories of the burn marks point toward two different crater fields on Ukrainian territory (image below). After analyzing the individual craters in the artillery strike site, we found that the calculated trajectories of the firing positions fit almost exactly the two trajectories determined from the artillery crater analysis of the crater field near the Dolzhanskaya-Capital mine.



Trajectories from the firing position north of Platovo to the target area around the Dolzhanskaya-Capital mine

Thus, from the evidence of crater field analysis, social media geolocation, and local media reports, the Bellingcat investigation team has determined that the artillery attacks on the Ukrainian armed forces positions near the Dolzhanskaya-Capital mine were conducted on 16 July 2014 from firing positions near Gukovo, within the territory of Russia.

## Video footage of the aftermath of the attacks

On 12 August 2014, the separatists, via their so-called “Information and Analysis Agency South East” posted two videos entitled “Destroyed position of the ‘heroic’ 72nd Brigade APU near Sverdlovsk, Lugansk region”<sup>30</sup>.

The Bellingcat investigation team has located the camera position of these videos as being in the crater field in the vicinity of the Dolzhanskaya-Capital mine<sup>31</sup>.



A shot from the video  
“Уничтоженная военная техника под Сverdловском 72 бригады ВСУ”<sup>32</sup>

The same destroyed military vehicles are clearly visible in the 8 August 2014 satellite image from Google Earth, taken just after the Ukrainian forces pulled out of this border area<sup>33</sup>.

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<sup>30</sup> <http://real-info.info/novorossiya/razbitye-pozitsii-gerojskoj-72-brigady-vsu-pod-sverdlovskom-luganskaya-oblast>;

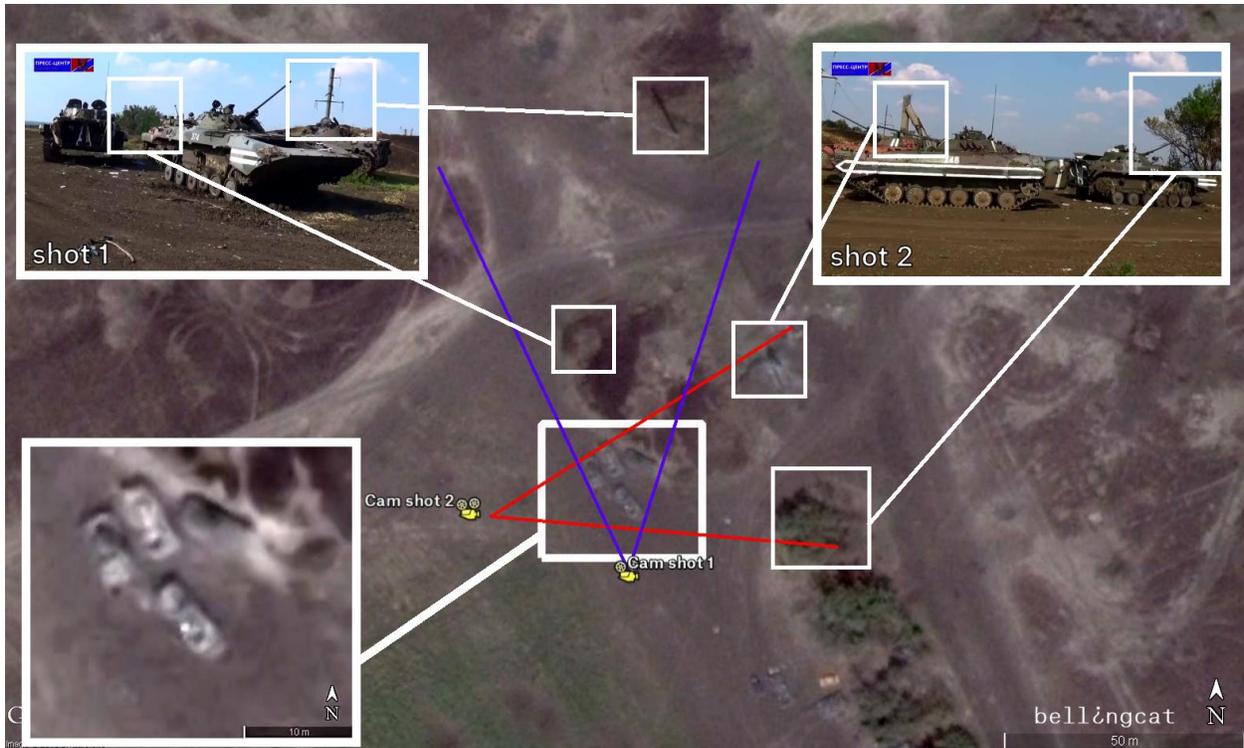
<http://web.archive.org/web/20140819175725/http://real-info.info/novorossiya/razbitye-pozitsii-gerojskoj-72-brigady-vsu-pod-sverdlovskom-luganskaya-oblast>

<sup>31</sup> <https://www.google.de/maps/place/48%C2%B001%2753.3%22N+39%C2%B044%2715.5%22E/@48.0314833,39.7376444,732m/data=!3m2!1e3!4b1!4m2!3m1!1s0x0:0x0>

<sup>32</sup> [https://www.youtube.com/watch?v=X\\_bpZMKlnN4](https://www.youtube.com/watch?v=X_bpZMKlnN4)

<sup>33</sup> [https://pressimus.com/Interpreter\\_Mag/press/3701](https://pressimus.com/Interpreter_Mag/press/3701);

[http://web.archive.org/web/20150210144851/https://pressimus.com/Interpreter\\_Mag/press/3701](http://web.archive.org/web/20150210144851/https://pressimus.com/Interpreter_Mag/press/3701)



Camera location for the scene from the video at 1:05



A shot of four damaged Ukrainian vehicles from the video  
 "Уничтоженная военная техника под Свердловском 72 бригады ВСУ"<sup>34</sup>

<sup>34</sup> [https://www.youtube.com/watch?v=X\\_bpZMKInN4](https://www.youtube.com/watch?v=X_bpZMKInN4)



Other shots from the videos

These videos show the extent of the destruction of the Ukrainian forces' equipment based close to the Dolzhanskaya-Capital mine. Many heavily damaged trucks and armored vehicles are visible in the video, including a truck, several BMP-2 units, a self-propelled artillery unit, BM-21 Grad launchers, and tanks.

## The Khmelnytskyi attack 25 July 2014

On 28 July 2014, the Russian news agency Ruptly published a video on YouTube entitled "Ukraine: Battle aftermath litters after Sverdlovsk militia pummels 72<sup>nd</sup> Motorized Brigade"<sup>35</sup>.



Shot from the Ruptly Video

Several abandoned and damaged armored vehicles are visible in this video. The video description also gives us a date for the attack:

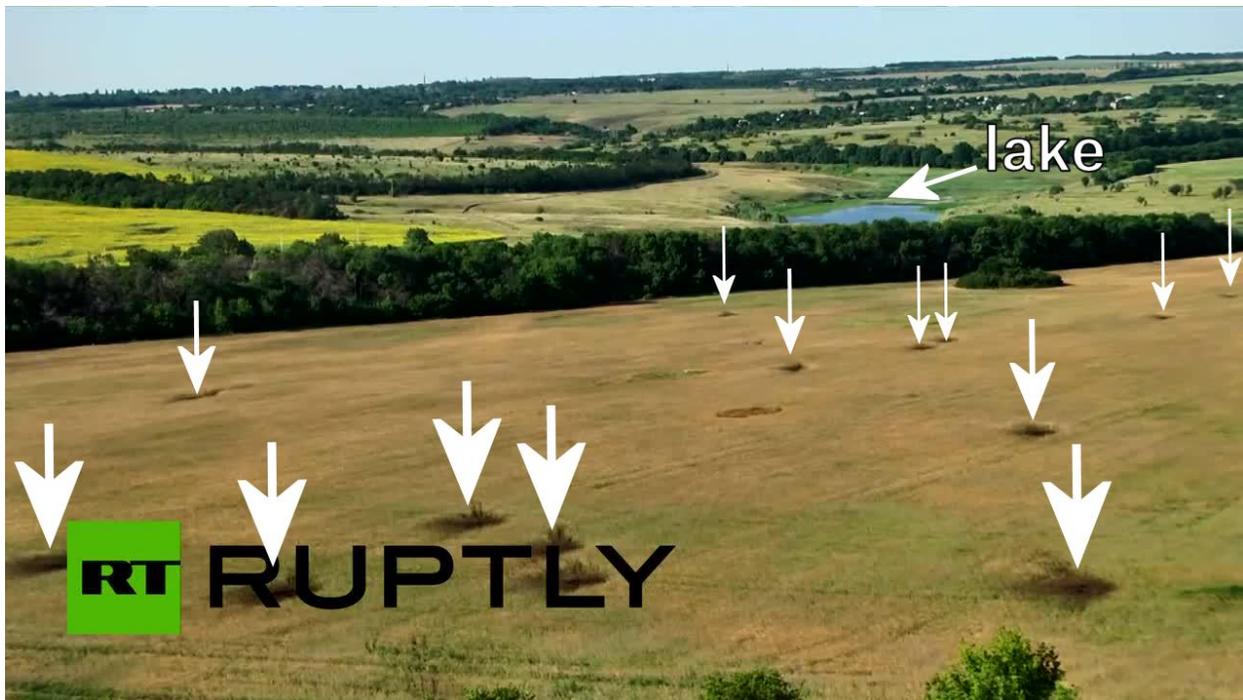
*Ukrainian Army BMP-2, MT-LB and rocket launchers were left abandoned near Sverdlovsk on Saturday, after the 72nd Motorized Brigade suffered heavy losses during mortar shelling from the Lugansk People's Militia on Friday. Lugansk People's Militia has said that heavy losses were suffered by the Ukrainian army in both hardware and personnel after the Kiev troops were hit by the 12mm [sic] mortar shells.*

The video was released on 28 July 2014, which means that the day of the attack (the previous Friday, as mentioned in the description) was 25 July 2014.

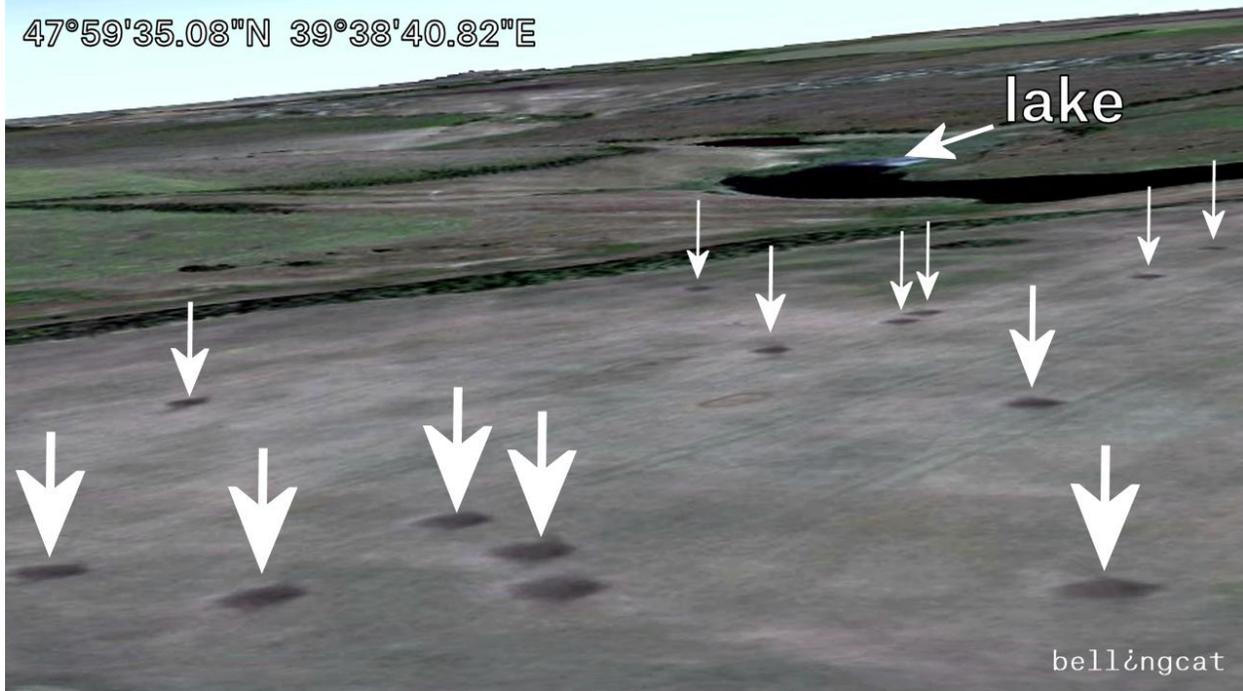
Using the video footage, the Bellingcat investigation team has located the camera location of the Ruptly video as being a crater field close to the village of Khmelnytskyi, south of Sverdlovsk.

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<sup>35</sup> <https://www.youtube.com/watch?v=kj7sE6dsuW0>



47°59'35.08"N 39°38'40.82"E



Comparison shot from the Ruptly video and the 15 August 2014 satellite image from Google Earth

Analyzing the satellite imagery, we found a total of 209 craters. We were also able to determine three primary attack trajectories.

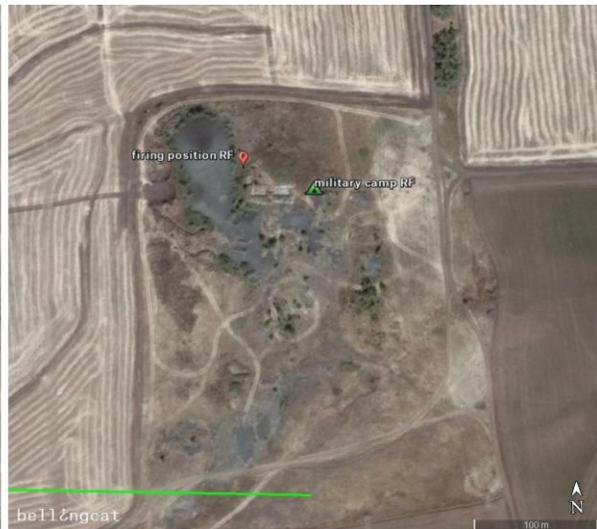


Result of the crater analysis at the village Khmelnytskyi, south of Sverdlovsk

The trajectories of nine craters point directly east (green line). Two other trajectories (red and cyan lines) originate from a southeasterly direction. All three trajectories clearly point to firing positions within Russian territory.



Firing position 1 and military camp  
Google Earth satellite image date 08 August 2014



Firing position 2 and military camp  
Google Earth satellite image date 08 August 2014

These firing positions are directly connected to the military camp of the Russian army near Pavlovka and a smaller firing position close to Malyy.

## Conclusion

The Bellingcat investigation team used internationally recognized methods and satellite imagery to analyze a total of 1,353 artillery craters in eastern Ukraine and determine their trajectories. We located firing positions that closely matched these trajectories, all of which were inside Russian territory with one exception, which was less than 2km from the Russian border.

Three artillery attack case studies were investigated in this report: Amvrosiivka (14 July 2014), between Dolzhanskaya-Capital mine and the village of Panchenkove (16 July to 8 August 2014), and Khmelnytskyi (25 July 2014). Our artillery crater analysis concluded that there were a total of ten primary attack trajectories across all the case studies. We identified firing positions from each of these attack trajectories. Nine of these firing positions were – without any doubt – within the territory of Russia, with three being within 400 to 800m of a military camp. The one position in Ukraine was near Chervonopartyzansk, within the territory of Ukraine, 1.2km south and 1.5km north of the border with Russia.

The target trajectory of three firing positions was determined through analysis of scorch marks created by MLRS fire. All three of these trajectories led precisely to the target area of the crater field, allowing our team to calculate the trajectories in both directions (i.e., from crater field to firing position and from firing position to crater field). Vehicle tracks are also visible and clearly showed that they originated from, and led back to, Russian territory near seven firing positions.

The firing position for an attack on 16 July 2014 in a field north of Gukovo, Russia was documented in a series of videos found on social media. Four of these videos show the same instance of 122mm MLRS fire from different perspectives. By comparing the video locations and views, the Bellingcat investigation team was able to geolocate the exact firing position. With a small deviation (300m at a shelling distance of 15km), the firing position geolocated through video analysis was the same as that derived from the crater analysis.

This study has provided compelling evidence that a series of artillery attacks on Ukrainian territory were conducted between 14 July and 8 August 2014 from firing positions within Russia. The first attack on 14 July originated from Russian territory near the Russian village of Seleznev and was directed towards positions of the Ukrainian armed forces south of the Ukrainian village of Amvrosiivka. Four attacks were conducted near Gukovo, Russia on Ukrainian armed forces close to the Dolzhanskaya-Capital mine and the village of Panchenkove between 16 July and 8 August. Two additional attacks were conducted on this area from Russian territory north of Gukovo. On 25 July, an artillery attack was conducted on the positions of the Ukrainian 72<sup>nd</sup> Mechanized Brigade near Khmelnytskyi village, south of Sverdlovsk. These attacks also came from locations within Russia, specifically from a military base in Pavlovka and a position east of the village of Malyy.

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Based on the original work of Sean Case

The Investigation team:

Timmi Allen  
Sean Case  
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Iggy Ostanin  
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