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A Bellingcat Investigation

Putin's Undeclared War Summer 2014 Russian Artillery Strikes against Ukraine

by Sean Case and Klement Ander



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Summary

Terms such as civil war or internal conflict are often used to describe the war in Eastern Ukraine. However, the available evidence no longer supports this view. During summer 2014, Ukrainian officials and also the U.S. government were already publicly stating that the Russian military were active in the war. A number of subsequent reports have corroborated these claims, documenting the presence and death of Russian servicemen in Eastern Ukraine, as well as the existence of Russian military equipment inside Ukraine.

In this report, an under-reported aspect of Russian military involvement in the conflict is fully investigated: artillery attacks against Ukraine in summer 2014. In previous reports such attacks were proven to have occurred on several occasions, but these reports could not fully describe the real extent of these attacks. Using open source evidence, this report attempts to document the full scale of the Russian artillery attacks against Ukraine in summer 2014. The main findings can be summarized as follows:

- Artillery units of the Russian Armed Forces fired *at least* on 149 separate occasions attacks against Ukraine in the summer of 2014. Another 130 locations were judged likely to have been used as artillery position.
- 408 artillery target sites inside Ukraine within range of Russian artillery systems have a trajectory crossing the Ukrainian-Russian border, 127 of them are within 3 km of the Russian border.
- In total, as evidenced by the number of impact craters, thousands of artillery projectiles were fired by the Russian military on targets inside Ukraine in the summer of 2014.

Due to the current lack of publicly-available satellite imagery evidence and the rigid classification criteria used here, these figures represent lower bound estimates of the true numbers of artillery attacks, i.e. there were likely considerably more than 149 attacks as already indicated by the 130 further likely artillery positions. Furthermore, it can be stated:

- Artillery attacks of the Russian Armed Forces from Russian territory began from early July 2014 and increased in frequency and scale into August and September 2014.
- Cross-border artillery attacks can be found in the entire border area of the conflict zone in the Donetsk and Luhansk regions.

Due to the frequency, spatial distribution, and scale of the artillery attacks considered in this report, it is impossible to consider these attacks merely as accidents or as the actions of rogue units. These attacks can only therefore be considered as acts of war of the Russian Federation against Ukraine.

We invite all readers to access the interactive map to see for themselves all of the data used to create this report¹.

¹ <https://bellingscatukraine.carto.com/builder/79a5c4ec-c29d-11e6-9676-0e05a8b3e3d7>

Introduction

When discussing the war in Eastern Ukraine – ongoing since 2014 – terms such as 'civil war' or 'Ukrainian conflict' are often used. However, the implication that the war as a solely-internal Ukrainian conflict is heavily disputed, and the fact of active Russian participation is increasingly accepted. Nevertheless, such claims have been strongly and repeatedly denied by the Russian government.²

Current knowledge strongly contradicts Russian official statements. A vast and growing amount of evidence either proves or strongly suggests heavy Russian military involvement, including the direct participation of the Russian Armed Forces in the fighting in Eastern Ukraine since July 2014.

During summer 2014, Ukrainian officials³ as well as the U.S. government⁴ were publicly stating that Russian servicemen were active in the war. There are now various reports available documenting their presence⁵ and death⁶. A recent report established that thousands of Russian servicemen were awarded with medals that are only given for participation in combat actions since summer 2014.⁷ Military equipment, either not used by the Ukrainian Armed Forces or observed being transported in Russia, was sighted or filmed inside Ukraine.⁸ Furthermore, vehicle tracks crossing the Russian-Ukrainian border likely related to the conflict

² https://www.washingtonpost.com/world/putin-denies-russian-troops-are-in-ukraine-decrees-certain-deaths-secret/2015/05/28/9bb15092-0543-11e5-93f4-f24d4af7f97d_story.html, <http://uk.reuters.com/article/uk-ukraine-crisis-russia-military-idUKKCN0WS0FB> and <http://www.bbc.com/news/world-europe-37045730>

³ <http://www.rnbo.gov.ua/en/news/1796.html>

⁴ <http://www.rferl.org/content/ukraine-russia-lying-invasion-us-samantha-power/26555401.html>, and <http://edition.cnn.com/2014/08/28/world/europe/ukraine-crisis/>

⁵ <http://www.telegraph.co.uk/news/worldnews/europe/ukraine/11056312/Russian-paratroopers-captured-in-Ukraine-accidentally-crossed-border.html>, <http://www.telegraph.co.uk/news/worldnews/europe/russia/11506774/Separatist-fighter-admits-Russian-tanks-troops-decisive-in-eastern-Ukraine-battles.html>, <https://www.theguardian.com/world/2015/mar/25/russia-ukraine-soldier>, <https://news.vice.com/video/selfie-soldiers-russia-checks-in-to-ukraine>, <https://www.bellingcat.com/news/uk-and-europe/2015/09/22/russias-6th-tank-brigade/>, <https://www.bellingcat.com/news/uk-and-europe/2015/11/13/136-brigade-in-donbass/>, <https://www.bellingcat.com/news/uk-and-europe/2016/01/16/russias-200th-motorized-infantry-brigade-in-the-donbass/> and <https://informnapalm.org/en/russianpresence/>

⁶ https://tvrain.ru/news/pskovskaja_gubernija_soobschila_o_gibeli_roty_desantnikov_v_ukraine-374888/, <https://www.theguardian.com/world/2015/jan/19/russia-official-silence-for-families-troops-killed-in-ukraine> and <https://www.bellingcat.com/news/mena/2014/08/27/revealed-around-40-russian-troops-from-pskov-died-in-the-ukraine-reinforcement-sent-in/>

⁷ <https://www.bellingcat.com/news/uk-and-europe/2016/08/31/russias-war-ukraine-medals-treacherous-numbers/>

⁸ <http://www.osce.org/ukraine-smm/186276>, https://www.bellingcat.com/news/uk-and-europe/2016/05/03/the_lost_digit/, <https://www.bellingcat.com/news/uk-and-europe/2015/05/31/avalanche/>, <https://www.bellingcat.com/resources/case-studies/2015/05/28/russias-pantsir-s1s-geolocated-in-ukraine/>, <https://www.bellingcat.com/resources/case-studies/2015/05/29/confirming-the-location-of-the-same-msta-s-in-russia-and-ukraine/> and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

in Eastern Ukraine, and close to military camps inside Russia could be identified in publicly-available satellite imagery.⁹

However, some of the first and strongest evidence of a direct Russian participation in the fighting was the documentation of cross-border artillery strikes from Russia on Ukrainian positions in July 2014. The existence of such attacks was already reported in 2014. For example, official Ukrainian sources reported fire from Russia on over 120 occasions in summer 2014¹⁰. US officials shared satellite imagery showing “attacks on Ukraine from Russia” and of self-propelled howitzers positioned in Russia close to Ukraine, on 27 July 2014.¹¹

Analysis of open source material, including publicly-available satellite imagery, social media evidence, and videos showing the launch of artillery rockets from multiple launch rocket systems (MLRS), revealed several cases of cross-border artillery fire originating from Russia attacking targets inside Ukraine.¹² With these Bellingcat reports from 2015 it was possible for the first time to clearly document a direct participation of the Russian Armed Forces using open source evidence.

Further reports have given us additional evidence of cross-border attacks.¹³ These previous reports investigated specific artillery attacks using mainly the limited satellite imagery available at the time. Recent additions of satellite imagery to Google Earth, Yandex, and Bing maps services now provides us with the evidence to map Russian artillery fire in 2014 to a much fuller extent. Documents published online after an alleged hack suggest that artillery unexploded shells / rockets were found inside Russia in the border area.¹⁴

The intention of this report is therefore not just to prove that Russian artillery was used against Ukraine in summer 2014, there are enough detailed case studies already proving this fact. This report instead attempts to estimate the overall scale of artillery attacks from or next to Russian territory against Ukraine during this period. We will show that Russian artillery was used on at least 149 occasions. Furthermore, in 136 cases, we present the likely attack targets of these firing positions. Finally, we will use key case studies to contextualize our findings.

⁹ <https://www.bellingcat.com/news/uk-and-europe/2015/09/21/bellingcat-investigation-russias-paths-to-war/> and <https://www.bellingcat.com/news/uk-and-europe/2016/06/15/9629/>

¹⁰ <http://www.rnbo.gov.ua/en/>, <http://dpsu.gov.ua/en/>

¹¹ <https://twitter.com/GeoffPyatt/status/493390505003069440>

¹² <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>, and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

¹³ <http://iphronline.org/wp-content/uploads/2016/07/Joint-report-on-cross-border-shelling-June-2016.pdf>,

<https://informnapalm.org/20408-vs-rossii-udary-po-ukraine/>,

<http://www.rferl.org/a/25472107.html>,

<https://informnapalm.org/en/russia-shelled-ukraine-in-august-2014/>

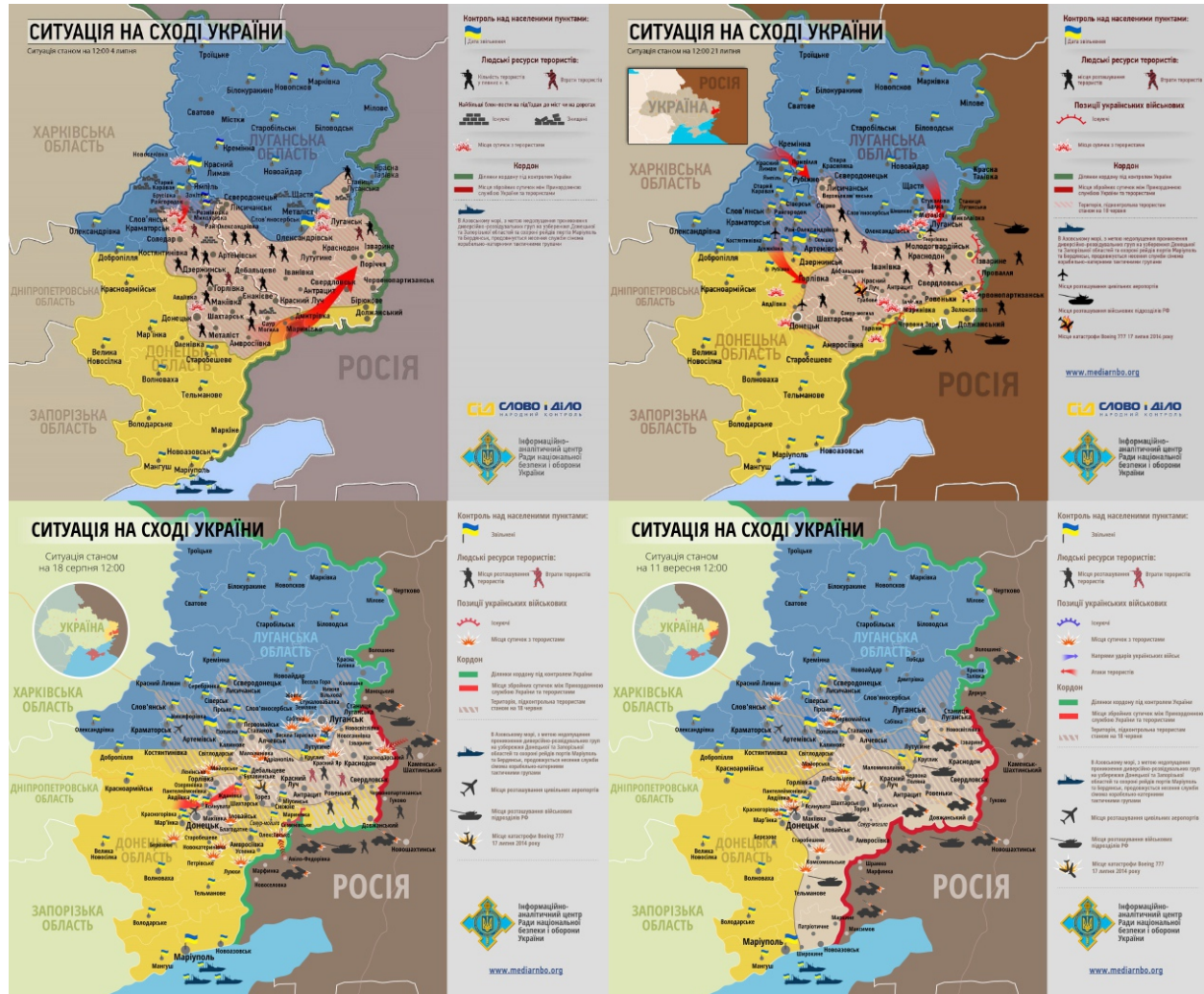
¹⁴ <http://web.archive.org/web/20161213084602/http://warinua2014.blogspot.dk/2016/03/blog-post.html>

Situation on the Ukrainian border in July / August 2014

The nature of the summer 2014 conflict in the border region of Eastern Ukraine allows us to analyze in detail the direct involvement of the Russian Armed Forces using open-source evidence. In this period, a number of cross-border attacks occurred originating from Russian territory using artillery systems such as howitzers or MLRS. Our evidence allows for direct attribution of responsibility to the Armed Forces of the Russian Federation.

The attacks from Russian soil on Ukrainian positions started shortly after Ukrainian forces began an offensive in the east to retake areas held by Russian-supported 'separatist' forces in June 2014. By early July, Ukrainian units had reached as far as Krasnodon (on the eastern border of Ukraine next to Donetsk, Russia), and a number of Ukrainian army camps were installed within 20 km of the border. These camps came under heavy artillery fire in the following weeks. Several of these attacks were investigated in full detail in a previous Bellingcat report¹⁵ that proved that many of them originated from inside Russia.

Starting in late June, local media and official Ukrainian sources began to report artillery attacks on Ukrainian positions close to the border, far from 'separatist' lines.¹⁶ In July, these



The approximate extent of territory held by Ukrainian and opposition forces according to the Ukrainian National Security and Defense Council. Top left: 4 July 2014; top right: 21 July 2014; bottom left: 18 August 2014; bottom right: 11 September 2014.

¹⁵ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

¹⁶ https://web.archive.org/web/20140626161443/http://dpsu.gov.ua/en/about/news/news_4315.htm

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attacks escalated in number and magnitude, and caught international attention following an artillery bombardment of a Ukrainian camp near Zelenopillya on 11.07.14¹⁷, which killed or injured dozens of soldiers. In subsequent weeks, the artillery bombardment of units in the border area increased, despite the downing of MH17 and growing international media attention on the conflict.

By 08.08.14, Ukrainian forces had to pull back from hundreds of kilometers of the Ukrainian-Russian border to the west, and fighting in the area was concentrated in the area of Marynivka, Savur-Mohyla, and Amvrosiivka. Eventually, a direct incursion by Russian forces across the border in late August 2014 towards the Luhansk airport, Ilovaisk, and Novoazov'sk¹⁸ pushed back all remaining Ukrainian forces from the border in the conflict areas of Donetsk and Luhansk regions.

¹⁷ <http://uk.reuters.com/article/uk-ukraine-crisis-idUKKBN0FF17R20140712>

¹⁸ <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

Method



The approximate search area for artillery target sites and firing positions, and the location of relevant towns and Ukrainian military camps.

We surveyed the area inside Ukraine within 22 km (approximate maximum range of a 122 mm DA18 howitzer) of the Ukrainian-Russian border in the Donetsk region, and the Luhansk region border as far as Nyzhnya Vil'khova. Further than this from the Ukrainian-Russian border, we observed that the vast majority of attacks came from within Ukraine rather than pointing to border. However, identified exceptions were retained within the analysis. Inside Russia, the entire area of the Rostov region adjacent to the search area in Ukraine was surveyed. However, given the range restriction of most artillery systems, the focus also rested on the border area. The search for attack sites or firing positions was done manually, primarily using Google Earth, and repeated for the different satellite imagery dates.

Within the search area in Ukraine and Russia, 2254 potential relevant sites were identified and considered. 1344 of them were found not to be relevant to the investigation. 518 of the remaining features are artillery crater attacks sites inside Ukraine, while 305 were classified as potential firing positions in Russia or close to the border inside Ukraine. Note that the 305 potential positions describe the number of potential strikes from the positions. If the visible traces indicate that more than one strike occurred from one position, each potential strike position is counted as one potential position in this report.

Evaluating the firing positions

Every potential firing positions were classified by two analysts; if there was no agreement between the two analysts, a third opinion was obtained. Only if two analysts agreed on the

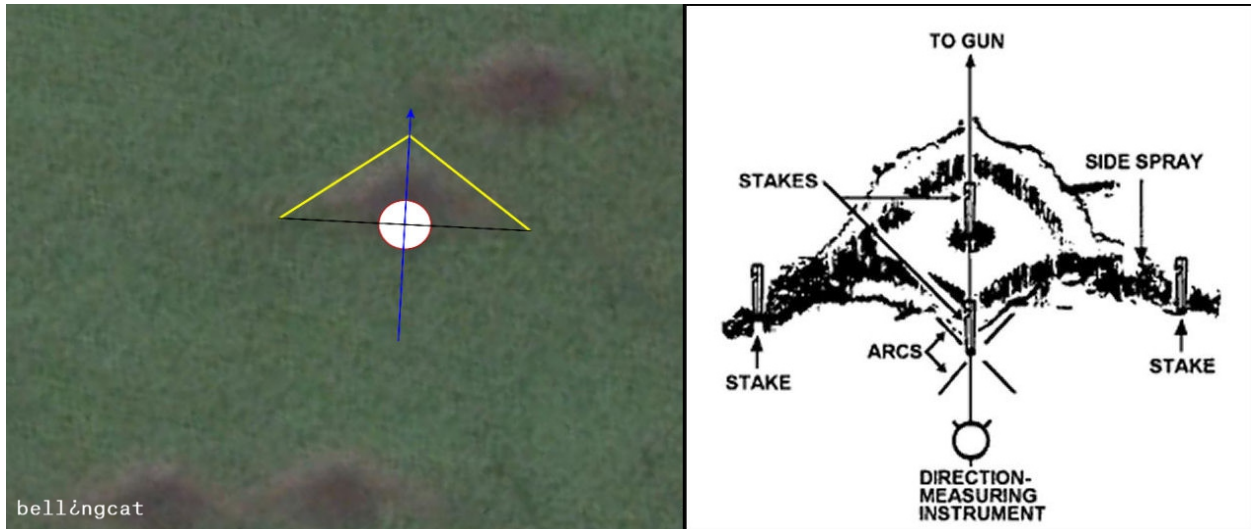
classification, a site is considered as a 'likely' firing position. 279 out of the identified 305 potential positions were classified as likely firing positions.

Likely firing positions were evaluated according to the likely type of artillery used (in particular the ground scarring by MLRS fire, hereafter referred to as 'blast marks', is quite distinctive), facing direction, date of appearance in satellite imagery, and number of visible marks. If visible marks strongly implied outgoing fire, the positions is classified correspondingly. For each position, an 'aiming trajectory' was also estimated based on the direction of five - if available - marks. In the case of outgoing MLRS fire this was determined from the orientation of the blast marks. In the case of assumed howitzer fire, the facing directions of vehicle marks or dug-in firing positions were used. Finally, in the case of visible vehicles, the orientation of the barrel was used to determine an 'aiming trajectory'.

Evaluating the attack sites

Attack sites within Ukraine were evaluated in terms of size of attack (small: 10 or less visible craters, medium: 10 to 100, and large: >100), date of appearance on satellite imagery, and trajectory. The trajectory was evaluated using a technique based on US military analysis¹⁹ and was similar to that used in previous Bellingcat reports,²⁰ a scientific report,²¹ and as evidence in the court trial of Nadiya Savchenko.²²

The trajectory evaluation technique differed in several crucial ways from previous Bellingcat analyses²³. Due to time constraints, it was impossible to fully evaluate the trajectories of each-one of the many thousands of artillery craters across the 518 attack sites. Therefore, an



Low-angle fuze quick craters (e.g. low-angle artillery or Multiple Launcher Rocket Systems fire). Image taken from previous Bellingcat report²⁴.

¹⁹ US Army Tactics, Techniques and Publications document ATTP 3-21.90 'Tactical Employment of Mortars', 2011 available here:

<http://armypubs.army.mil/Search/ePubsSearch/ePubsSearchDownloadPage.aspx?docID=0902c851800123f1>

²⁰ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/> and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

²¹ http://www.aaas.org/geotech/sri_lanka_2009

²² <https://www.bellingcat.com/news/uk-and-europe/2016/03/25/russian-prosecution-cites-bellingcat-methods-in-savchenko-trial/comment-page-1/>

²³ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

²⁴ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

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High-angle shell craters (e.g. mortars, high-angle Multiple Launcher Rocket Systems fire). Image taken from previous Bellingcat report²⁵.

evaluation method was developed to estimate the artillery target site trajectory more quickly.

A previous Bellingcat report²⁶ found that for an 'ideal' crater site of several hundred craters derived from one attack direction ninety percent of the trajectories were grouped within 12 degrees bearing. In order to determine a general trajectory bearing in this report, five craters were selected from each attack site, and the trajectory was evaluated based on this sub-sample. Comparing the results from the full crater analysis described in the previous Bellingcat report and this method, we found that the analyzed bearings varied by $3 \pm 3^\circ$ standard deviation (10 comparisons made).

To account for the uncertainty in trajectory in our analysis for this report, the bearing derived from the new technique was converted into a cone buffer sourced from the centroid of the attack polygon with a bearing variation of 6° on each side. Buffers were created using the EPSG projection 32637 (WGS 84 / UTM zone 37N). Using this technique, we identified 408 attack sites that had a trajectory that crossed the Ukrainian-Russian border.

Linking attack crater fields with firing positions

We attempted to determine which of the attack sites in Ukraine were linked to specific artillery firing positions in Russia. In order to link these features, we developed a conservative method to minimize the false identification of links.

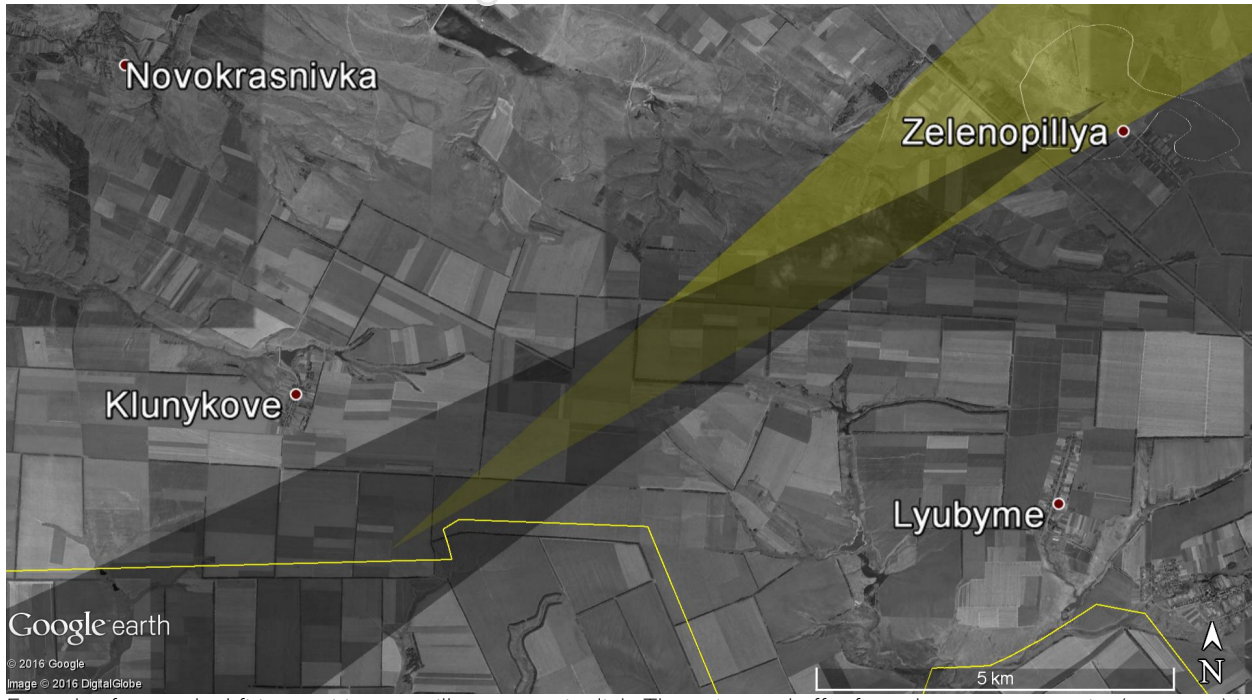
First, we determined the facing direction of the firing positions as described earlier in this section. The derived 'aiming trajectory' was converted into a cone buffer of angle variance 12 degrees bearing (see image on the next page for an example). For the artillery target sites, the 'trajectory evaluation' method described in the last subsection was used. Where previous analysis on a larger number of craters / firing positions was available, these trajectories were used instead. This is the case specifically for the attacks considered in previous reports,²⁷ and attacks in the area of Zelenopillya and Biryukove.

The attack site and firing position cones were intersected over markers indicating the centroid of the attack site and the firing position (see image on the next page for an example). Only attack sites that were 'double-matched' were retained; i.e. an artillery target site intersected with a firing position cone buffer, and the firing position intersected with the artillery target site trajectory buffer of the corresponding artillery target site.

²⁵ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

²⁶ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

²⁷ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/> and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

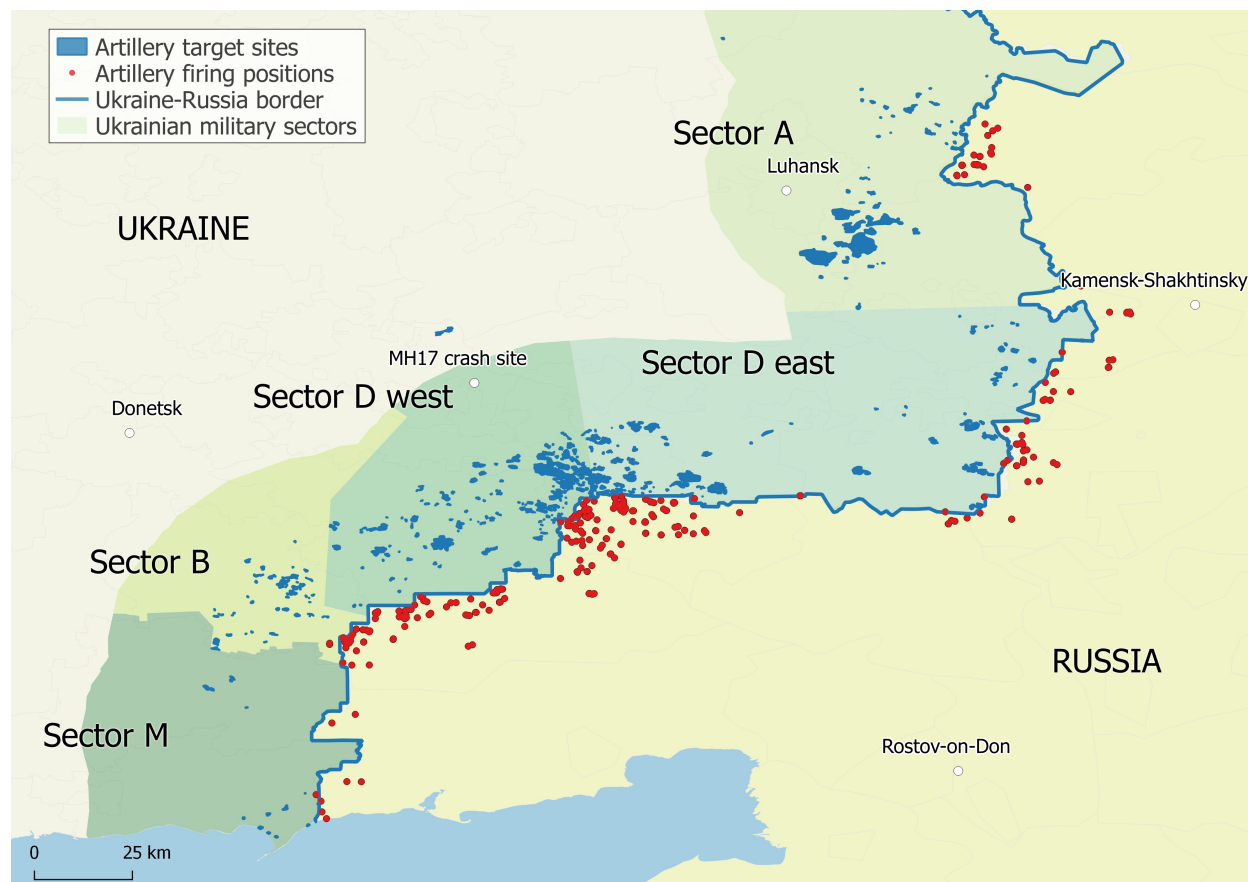


Example of a matched firing position to artillery target site link. The trajectory buffer from the target crater site (grey cone) is overlapping the firing positions, and the firepoint facing buffer is overlapping the target crater site (yellow cone).

Matched attack site-firing positions that did not fulfill the following rules were removed in a second step:

- Linked attack sites and firing positions with non-matching dates for satellite images
- Firing positions further than 2 km from the Russian border.
- Firing positions possibly not linked to Russian activity.
- Linked attack distances < 2 km and greater than 28.9 km - the maximum range of a 152 mm 2A65 field howitzer.

Findings



The location of attack sites and firing positions according to the military sector of the Ukrainian Anti-Terrorist Operation.

We identified 518 crater fields indicating attack sites, and 305 potential firing positions that were judged to be possibly related to cross-border attacks. The location of these features are shown in the figure above according to the relevant military ATO sector.²⁸ The locations and details of these features can be viewed in detail on the online interactive map accompanying this publication.²⁹

Firing positions

We surveyed artillery firing positions inside Russia or close to the border inside Ukraine. In total, we found 288 potential firing positions inside Russia. A further 17 potential firing positions were identified inside Ukraine close to the Russian border (less than 2 kilometers away). While being not in Russia, these firing positions were nevertheless considered to be related to the Russian army. In all 17 cases, it was possible to find a potential track from the firing position that led back to Russia.

26 out of these 305 potential firing positions, all of them inside Russia, were not classified as likely firing positions because the visual evidence available lacked clear indicators of an artillery position or outgoing fire, e.g. no blast marks or vehicles are visible. These sites were labeled as 'possible' artillery positions.

²⁸ https://web.archive.org/web/20160911162526/http://www.depo.ua/static/files/gallery_uploads/images/%D0%9C%D1%96%D0%BD%D0%BE%D0%B1%D1%8C%D0%BE%D1%80%D0%BE%D0%BD%D0%B8.jpg

²⁹ <https://bellingscatukraine.carto.com/builder/79a5c4ec-c29d-11e6-9676-0e05a8b3e3d7>



Example of a firing position with visible field artillery and marks of outgoing fire as evidence of firing. West of Petropolye, Russia (47.693467 38.828665).

149 out of 279 likely firing positions inside or within 2 km of Russia and linked to Russian activity show clear or likely signs of outgoing fire. The above figure shows an example of one of these features. The satellite imagery clearly shows a field artillery firing position with marks of outgoing fire. The artillery position was positioned west of Petropolye in Russia.

On 23.07.2014, six field howitzers, likely of type Msta-B (2A65), are visible in the satellite imagery. The barrels point roughly towards the north-west. The distance between the Russian-Ukrainian border and the howitzer position in this direction is approximately 5.6 km. Dark marks are visible beside the howitzers on both the left and right of the barrel. These marks are also visible in the next satellite imagery from 26.07.2014. These marks are interpreted as signs of outgoing fire from this position.

On the bottom right is an image which was uploaded on 23.07.2014 to the VK account of a Russian artilleryman with a geotag located in the same general area. The imagery shows two Msta-B howitzers in firing position. Together with the image, the soldier uploaded the following text: "Been shelling Ukraine all night".³⁰ It was not possible to establish with certainty that the satellite imagery and image shows the same scene; however, images uploaded by the same soldier have a geotag pointing to the treeline behind the howitzers, indicating his presence in the area.

³⁰ <http://euromaidanpress.com/2014/07/23/russian-soldier-boasts-shelling-ukraine-all-night-on-social-network/#arvlbdata>

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Example of a firing position with visible field artillery but with no visible evidence of firing. West of Petropolye, Russia (47.709255 38.862312).

Not all positions show traces of outgoing fire. In the above figure, satellite imagery shows another likely artillery position in the same general area. On 26.07.2014, there are clearly five field howitzers in position visible. The barrels point roughly in a north-north-westerly direction. The distance between the Russian-Ukrainian border and this position is around 12.5 km in this direction. Satellite imagery shows that the position was abandoned on 02.08.2014. While there are clearly visible traces left behind that document that artillery was positioned there, there are no distinct marks indicating outgoing fire (unlike at other positions visible in this area). Therefore, while this position is clearly a likely firing position, it is classified as one without visible signs of outgoing fire.

A similar approach as described above was used for all other firing positions located via satellite imagery. If there were no traces indicative of artillery fire, it is classified as only a likely firing position. If relevant visible evidence is available, it is classified as a likely firing position with signs of outgoing fire. In most cases, no vehicles are visible in the available satellite imagery at the firing positions; therefore, the assessment mostly relied on analyzing the traces left behind by the vehicles.

Another type of artillery system used by the Russian army for cross-border attacks were MLRS. A common example is the BM-21 Grad, which was and is widely used by both sides in the war, and can fire up to 40 122-mm rockets in one salvo. Outgoing fire from MLRS artillery rocket systems leaves distinct traces on the ground. These traces clearly differ from the marks left by field howitzers.



Example of MLRS firing positions with visible blast marks resulting from multiple attacks from this area. Near Primiuskiy, Russia (47.853066 38.933313).

As described in an earlier Bellingcat report³¹, these distinctive blast marks are created due to the way an MLRS operates. It was possible to confirm this through the identification of a likely Ukrainian firing position³² at which MLRS vehicles were standing in formation and recent blast marks were visible behind them (likely Ukrainian military firing positions were not included in further analysis for this report). In case of MLRS fire, the orientation of the blast marks indicates the firing direction directly. 88 of the 149 firing position with signs of outgoing fire showed clear traces indicating outgoing MLRS fire.

In the above image, a position near Primiuskiy is presented. Blast marks, left by the outgoing MLRS fire, that are not visible in the 04.08.2014 satellite imagery are clearly visible on 30.08.2014. The orientation and overlapping of the individual blast marks indicates that multiple attacks against Ukraine originated from this location. The color around the blast marks in the 04.09.2014 satellite imagery allows for the separation of the individual attacks for this area.

From the 15 visible blast marks, it was concluded that at least four different attacks were launched from this area. It is possible to clearly identify at least three different firing directions; in the case of the most north-north-western direction, the difference was too small for a definitive assessment. The distance to the border from this location ranges from 2.3 km to 4.5 km. As described in the methodology section, each assessed attack from the area is counted as a separate firing position in our data set.

³¹ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>

³² 47.870354 38.792733 (02.07.2014)

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Example of MLRS firing positions with visible blast marks inside Ukraine. West of Pavlovka, Russia (47.944487 39.805530).

17 out of 279 identified likely firing positions are inside Ukraine, but were nevertheless assessed as related to Russian military activity. The above image gives an example of an area with four visible blast marks from outgoing MLRS fire inside Ukraine just west of Pavlovka, Russia. The distance to the Ukrainian-Russian border is approximately 50 m. The satellite imagery shows that between 16.07.2014 and 25.07.2014 one attack was launched from this area, and a second was launched between 25.07.2014 and 08.08.2014. Therefore, two different attacks from this area are recorded in the data set. The 08.08.2014 satellite imagery³³ shows a clear track crossing the border which connects the firing position with a known Russian military camp near Pavlovka.³⁴

For all 17 likely firing positions inside Ukraine (but within 2 km of Russia), a comparable analysis method was used. A firing position was only categorized as 'likely Russian' if a track between the firing position and the Ukrainian-Russian border was identified and this track was assessed as likely route for the artillery vehicles / 'artillery fire' teams. In all 17 cases a route towards Russia was considered as more likely than an inner Ukrainian route. However, only 12 of the 17 likely firing positions show clear signs of outgoing fire. Two of them are assessed as likely mortar positions, the other ten positions show blast marks of outgoing MLRS fire. Therefore, of all likely firing position with signs of outgoing fire, around 8 % (12) fall in this category and are inside Ukraine, and around 92 % (137) are clearly inside Russia.

³³ However, a comparison between the 16.07.2014, 25.07.2014 and 08.08.2014 imagery shows that the track crossing the border is already visible in the 25.07.2014 imagery.

³⁴ <http://www.atlanticcouncil.org/publications/reports/hiding-in-plain-sight-putin-s-war-in-ukraine-and-boris-nemtsov-s-putin-war>

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Overview over likely firing positions and firing positions with signs of outgoing fire

| | Category | Number | Number of marks ² | Vehicles visible ³ | Number of vehicles |
|-----------------------------|--|--------|------------------------------|-------------------------------|--------------------|
| Inside Russia | Likely firing positions | 125 | 0 (484) | 30 | 162 |
| | Firing positions with signs of outgoing fire | 137 | 503 (45) | 18 | 81 |
| | Sum | 262 | 503 (529) | 48 | 243 |
| Inside Ukraine ¹ | Likely firing positions | 5 | 0 (26) | 0 | 0 |
| | Firing positions with signs of outgoing fire | 12 | 58 (5) | 0 | 0 |
| | Sum | 17 | 58 (31) | 0 | 0 |
| All | Total Sum | 279 | 561 (560) | 48 | 243 |

¹ within 2 km of Russia, assessed as Russian firing position.

² the first number states the number of traces indicating outgoing fire, the number in brackets indicates other marks (a rough interpretation of this number would be: number of vehicles without clear signs of outgoing fire).

³ Only field howitzers, self-propelled howitzers or MLRS are relevant and counted.

The above table summarizes the findings presented so far and provides additional information regarding the different categories of firing positions. In total, over 500 visible marks indicating outgoing fire could be identified inside Russia, almost 60 further marks could be identified inside Ukraine within 2 km of Russia. 331 of these marks were assessed as blast marks caused by outgoing MLRS fire.

Beside these likely or clear signs of outgoing fire, other marks, e.g. vehicles tracks or vehicle positions, could be identified. While these marks do not document directly outgoing fire, they allow for an estimation of the number of vehicles in any single location. In total, 560 such visible marks could be identified.

Furthermore, it was possible to specifically identify the artillery systems at a number of firing positions. All firing positions with visible vehicles are inside Russia – and most of them showed either field or self-propelled howitzers. In total, vehicles are visible at 48 out of 279 positions, and 18 of them show also signs of outgoing fire. In total, 243 individual field howitzers, self-propelled howitzers, and MLRS systems are visible.

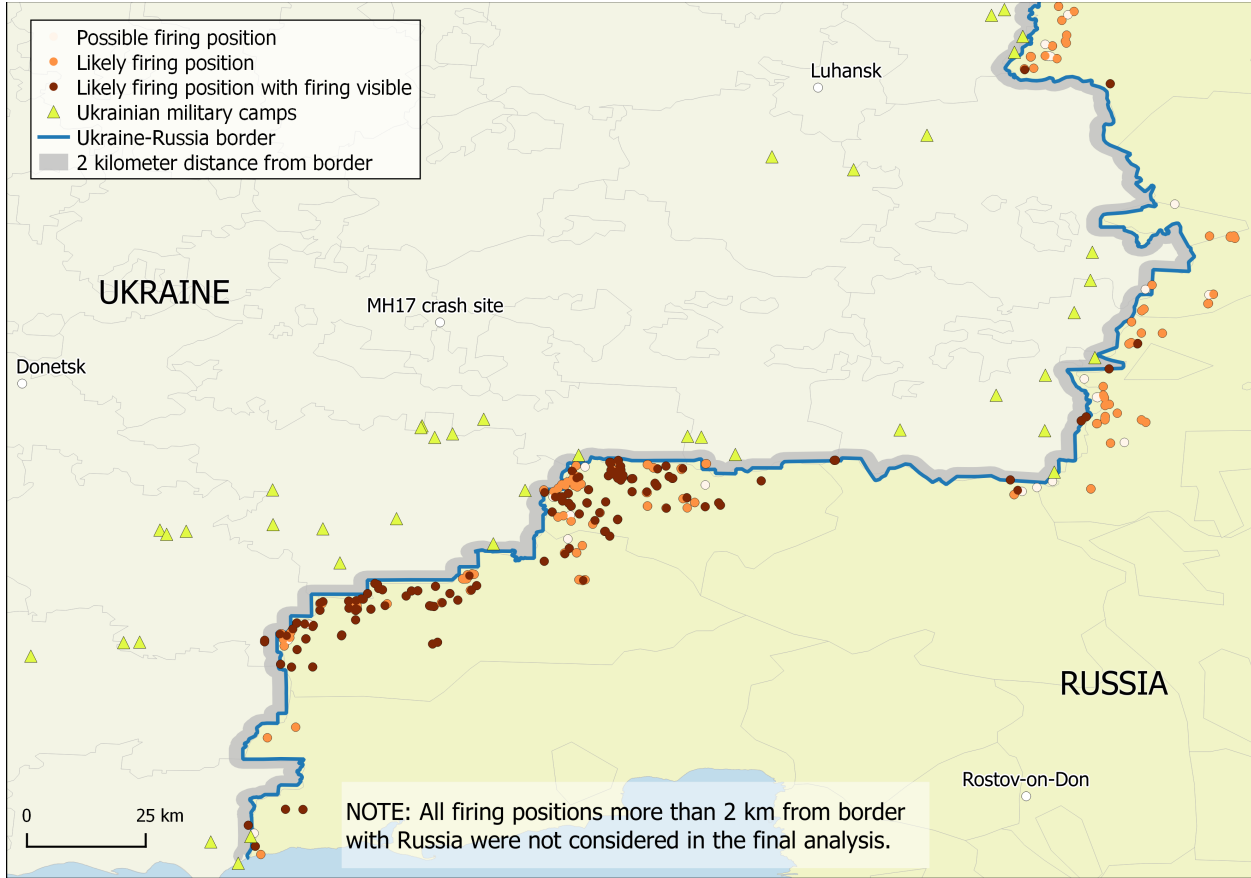
Note, that the applied principles limit the interpretation of our results. With the available data, it is only possible to state an estimate for a *lower bound* of Russian artillery attacks against Ukraine in the summer of 2014. 137 positions inside Russia and further 12 positions inside Ukraine (but within 2 km to Russia and assessed as related to Russian military activity) show signs of outgoing fire. Using these identified positions / attacks leads to an extremely conservative estimate of the *lower bound* (using only the attacks launched from inside Russia), or including the attacks launched inside Ukraine, a conservative estimate of the *lower bound* of the number of attacks in summer 2014.

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The estimated lower bound should not be interpreted as a precise estimation of the total number of attacks that actually occurred, a number which is most likely clearly larger. This is documented by the large number of likely artillery positions without signs of outgoing fire, and also by areas where the number of identified positions with signs of outgoing fire is much lower than the number of the target artillery crater sites within range of these firing positions.³⁵ However, our estimated lower bound allows us to get an impression of the scale of the Russian artillery war against Ukraine in this period.



An overview of the artillery firing positions considered in this report.

³⁵ See the following two sections for more details about the attacked areas and the linking of likely firing positions and attacked areas.

Attack sites

Another key piece of evidence in the analysis of cross-border artillery fire is the analysis of artillery craters at the target sites within Ukraine. To identify attacked areas, we surveyed the entire area in the conflict zone close to the Ukrainian-Russian border inside Ukraine. If the estimated trajectories suggested more than one attack at this area, each of these attacks was considered separately. After the initial survey, the identified attack sites were screened for their relevance for this report and only attack sites with a trajectory pointing clearly to Russia were considered further.

To determine their relevance for further investigation, the general trajectory of the craters forming the crater field was used. 518 attack sites were initially judged to potentially be in range of artillery fire, and have a trajectory roughly facing towards Russia. After analyzing the trajectories of these attack sites in more detail (as described in the methods section), 408 of them were determined to have trajectories that crossed the Ukrainian-Russian border (maximum range considered was 28.9 km, the maximum range of a 152-mm 2A65 howitzer).

The image below shows one example of an attacked area. The attack occurred between 23.07.2014 and 26.07.2014 and resulted in more than 20 visible craters on satellite imagery. The attacked area lay mainly inside Ukraine and is north of Novaya Nadezhda, Russia; however, some craters were located inside Russia. The estimated trajectory of the craters points toward a launch area in a south-western direction and therefore almost completely precludes the possibility of an attack by Ukrainian forces.



Example of an attacked area north of Novaya Nadezhda, Russia (47.870206 39.065930)



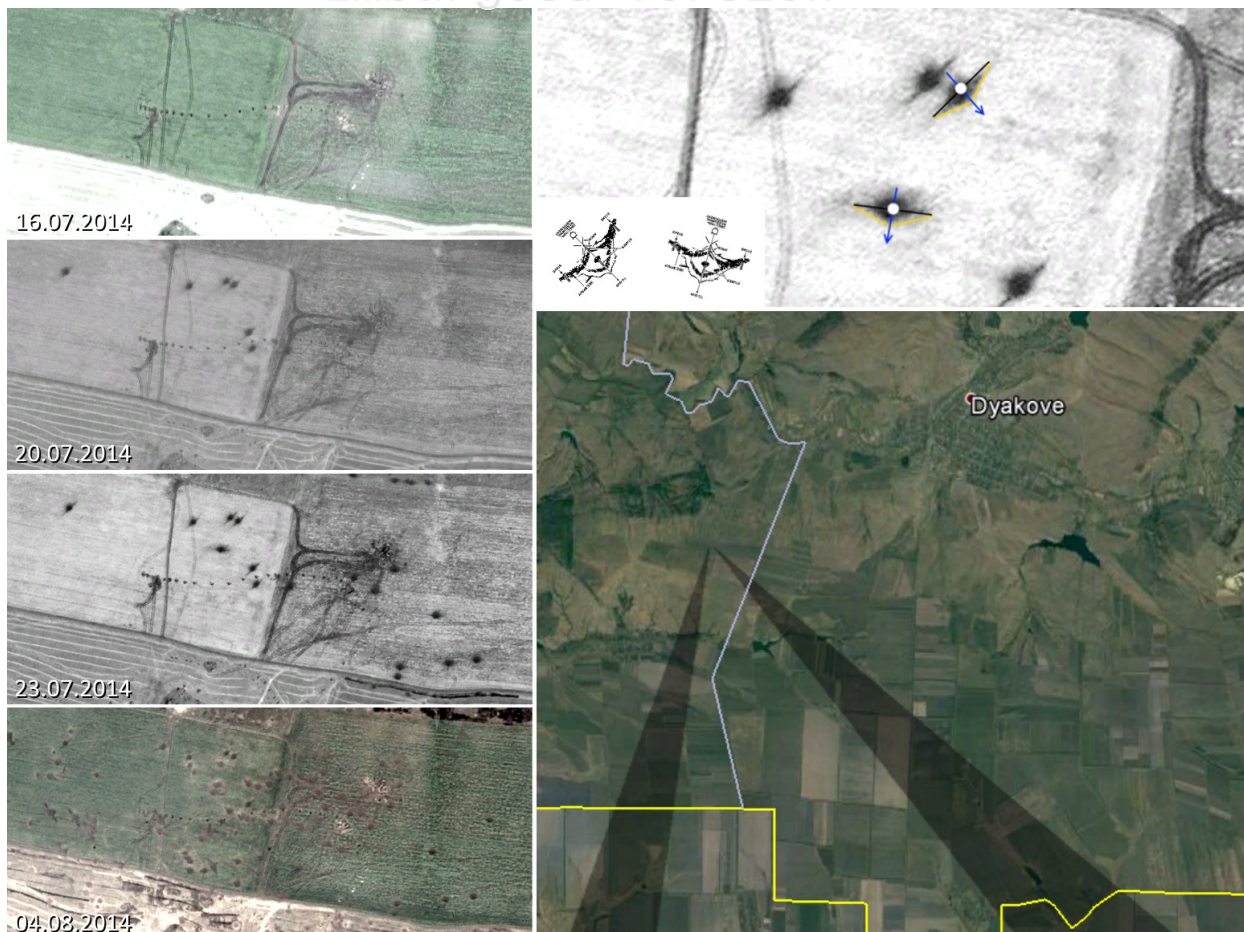
Example of an attacked area west of Marynivka, Ukraine (47.902522 38.820330)

However, such a clear identification of the responsible side for the attack was not possible in all cases. The image above presents one such example. The attack which led to the visible craters occurred between 02.07.2014 and 16.07.2014. Over 20 craters are assessed to be pointing approximately in the same direction towards the south east, and can be identified on the satellite imagery in the general area of the attack. The closest distance of the crater field to the Ukrainian-Russian border is around 4.8 km.

Between the Ukrainian-Russian border and the crater field lay a likely Ukrainian camp and the Marynivka-Kuybyshevo border crossing, both marked in blue on the satellite imagery. On the Russian side of the border, one of the largest concentrations of Russian troops in proximity to the Russian-Ukrainian border in 2014 was located.³⁶ Without additional information (e.g. the exact date and the target of the attack) a clear attribution of the crater field to one sides or the other is not possible. While the trajectory points toward Russia, in this case, it is also possible that the Ukrainian army fired the artillery that created these craters.

While in the above case it is not possible to clearly attribute responsibility to one side, in the majority of the considered cases, an attribution of the attacks to the forces fighting against Ukraine is possible with a high level of confidence. For example, in most cases the attacked target was a known Ukrainian military camp / position, or the attacked area was known to have been under Ukrainian control at the time of the attack.

³⁶ <https://www.bellingcat.com/news/uk-and-europe/2015/09/21/bellingcat-investigation-russias-paths-to-war/>



Example of a multiple attacked area north-east of Dibrivka, Ukraine (47.918906 39.063780).

One of the clearest examples inside Ukraine is presented above. The attacked area close to a Ukrainian military position north-east of Dibrivka is approximately 5.3 km from the Russian border. The first attack at this area occurred between 16.07.2014 and 20.07.2014. Six craters pointing to a launch site in a south-easterly direction are clearly visible.³⁷

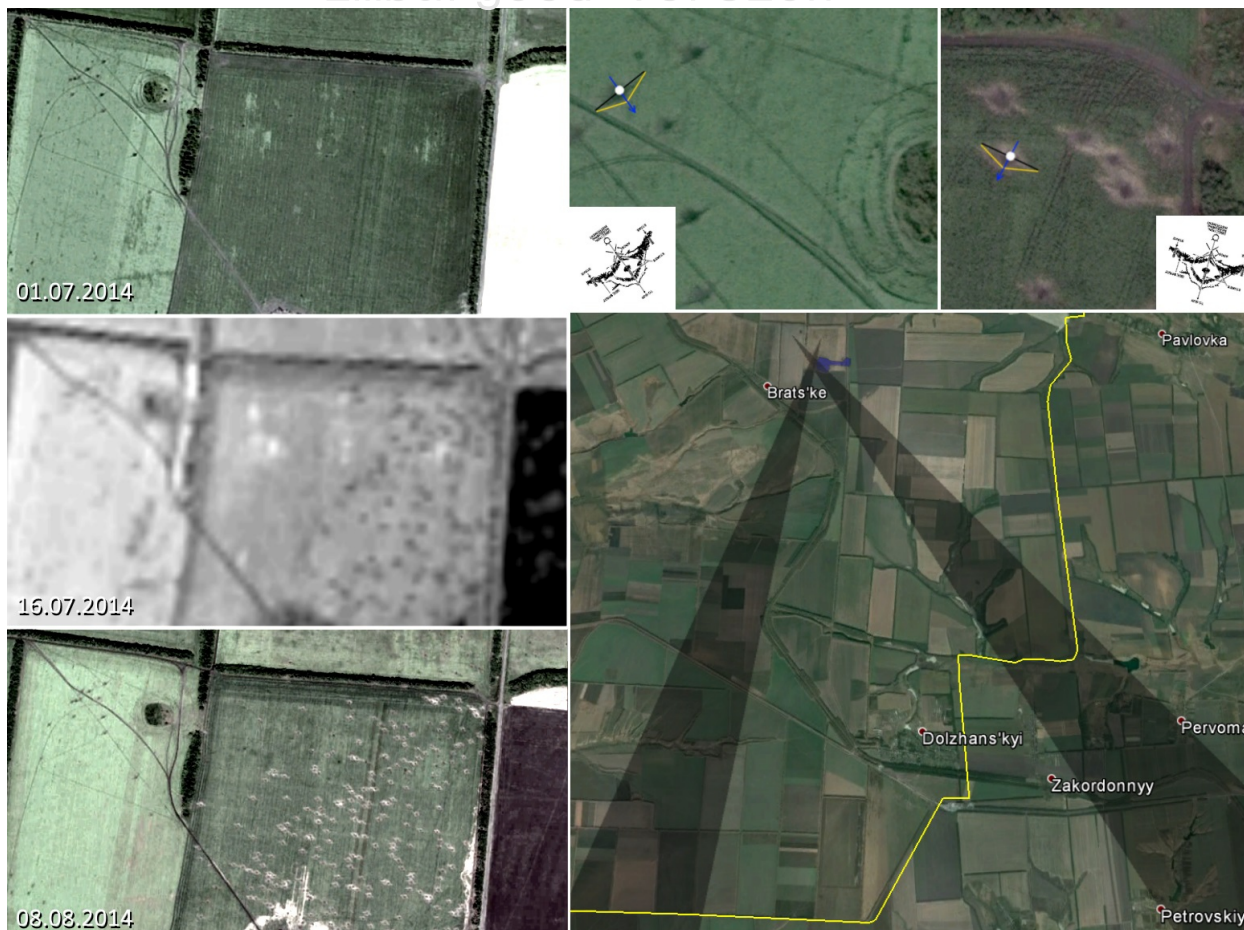
Furthermore, north-west of these six craters more than 20 additional craters are visible. Most of them do not allow a clear assessment of the trajectory, but some also suggest a launch site in a south-easterly direction, indicating that all craters were the result of the same attack. Between 20.07.2014 and 23.07.2014, another attack occurred, leaving again more than 20 craters at this area. The new craters clearly point in a different direction, almost towards the south.

The satellite imagery from 04.08.2014 shows numerous new craters in the area, so that by this time far more than 100 craters had appeared. The estimated trajectories from these craters suggest attacks from a minimum of three different firing positions for the attacks between 23.07.2014 and 04.08.2014³⁸, all of which point toward the Ukrainian-Russian border. We can therefore conclude that this area was attacked at least five times between 16.07.2014 and 04.08.2014, and all attacks were most likely cross-border attacks originating from Russia.³⁹

³⁷ 600 m east of this crater field is another crater field with a different trajectory visible.

³⁸ At least one of these new attacks occurred between 23.07.2014 and 26.07.2014, documented by new craters visible in the area in the 26.07.2014 satellite imagery.

³⁹ An analysis of the crater fields in the larger region around this place can be found in the case study section.



Example of a multiple attacked area north-east of Brats'ke, Ukraine (47.926975 39.733494).

It was not possible to constrain the date of an attack to within a small range of possible dates based on available satellite imagery alone (e.g. from Google Earth). The above imagery shows attacks at a Ukrainian camp near Brats'ke. Google Earth has until now only imagery showing the area on 01.07.2014 and 08.08.2014; the latest available imagery before 01.07.2014 is from 2013. Therefore, the imagery in Google Earth only shows the area at the beginning of the Ukrainian operation to regain control over the border area and the time shortly after their retreat from the area.

However, it is possible to determine the date of larger attacks with preview imagery available from Digital Globe. The preview imagery of the area from 16.07.2014 shows craters from a larger attack that are not visible in the 11.07.2014 preview imagery of the same area. With the preview imagery it is therefore possible to considerably narrow down the date of the attack to between this range of dates.

In total, craters from at least three different attacks are visible in the area. Already in the 01.07.2014 satellite imagery, artillery craters are visible to the north-west of the Ukrainian camp. The craters have a trajectory from a south-easterly direction. The distance to the Ukrainian-Russian border in this direction is around 8.8 km. The Digital Globe preview imagery shows that between 11.07.2014 and 16.07.2014 a larger attack at the area occurred. Numerous new craters are visible in the preview imagery. Not all craters of this attack are still visible in the 08.08.2014 satellite imagery in Google Earth. The craters in the field east of the camp are no longer visible. However, it can be assessed that this attack resulted in far more than one hundred artillery craters. A comparison between the 16.07.2014 preview imagery and the 08.08.2014 satellite imagery reveals further that at least one further attack must have

occurred between 16.07.2014 and 08.08.2014; in the western part of the field north of the camp are new craters visible in the later imagery. However, the 08.08.2014 satellite imagery also allows for the assessment that both attacks came approximately from the same direction, there is no notable difference in the estimated trajectories. The craters point to launch sites towards the south-south-west; the distance between the target area and the border is around 11.3 km in this direction.

The craters already visible on 01.07.2014 in this area are especially noteworthy. Until now, the start of the Russian cross-border attacks was widely assumed to be between 11.07.2014 and 16.07.2014. Cross-border attacks in this period are clearly documented. However, the estimated trajectory from these craters also points toward the Ukrainian-Russian border and suggests that the Russian attacks on the Ukrainian troops might have started at an earlier date, albeit at a smaller scale than the attacks that occurred on 11 July and afterwards.

Given the repeated attacks on certain areas and resulting overlapping attack sites, it is quite plausible that not all individual artillery attacks are recorded in this analysis. The number of attack sites should therefore be considered to be a lower-bound estimate. Furthermore, not all attacks were of similar scale. Therefore, all identified attack sites with trajectories crossing the border were - after the identification and assessment of their relevance - roughly classified given the number of visible craters: 35 attacks were assessed of being of large scale (more than 100 visible craters), 205 of medium scale (> 10 and ≤ 100 visible craters), and 168 of small scale (10 or fewer visible craters). The table below summarizes this classification.

Overview over number of attacks sites separated by their assessed scale

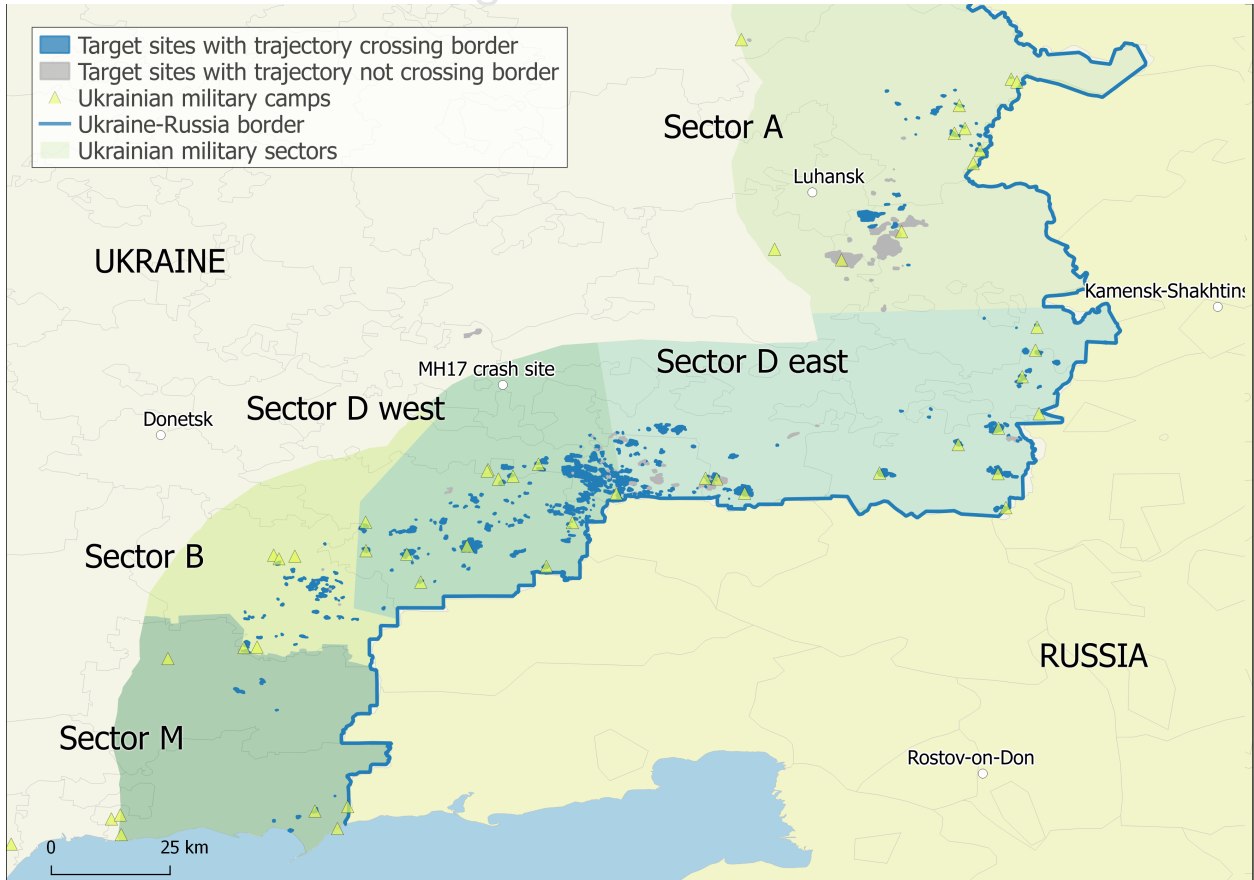
| | Small (1 - 10) | Middle (11 - 100) | Large (> 100) | Sum |
|---|-------------------|----------------------|------------------|-----|
| Trajectory not crossing the border ¹ | _2 | _2 | _2 | 110 |
| Trajectory crossing the border | 168 | 205 | 35 | 408 |

¹ includes attack sites with unknown trajectory

² not assessed

The identification of the attack sites is only half of the story when considering cross-border artillery fire. Theoretically, if there is a moderate distance to the border, even attacks with a trajectory crossing the Ukrainian-Russian border could plausibly be the result of artillery fire from inside Ukraine, in some cases even from Ukrainian forces. In fact, as shown in the last section summarizing the finding for the firing positions, there were attacks of the Russian army that were launched from inside Ukraine. However, many attack sites were so close to the border that the possibility of artillery fire from inside Ukraine could be discarded, e.g. 127 artillery attacks with trajectories coming from Ukrainian-Russian border were located within 3 kilometers of the border (the minimum range of a BM-21 Grad MRLS or a D-30 122-mm howitzer is approximately 4-5 km).

From previous reports, we already know that cross border attacks occurred in summer 2014. However, this analysis has shown that they occurred much more frequently than was previously known, and often on a large scale. Given the large number of identified firing positions inside Russia and the large number of identified attack sites inside Ukraine with trajectories pointing across the border, it is very likely that a large majority of the identified target sites are in fact a result of Russian artillery fire launched from Russian territory. The next stage of our analysis was to try to link the firing positions with their specific targets in Ukraine.



An overview of the artillery target sites considered in this report.

Linked attacks

In the previous two sections, the findings for the firing positions and attacks sites were presented separately. On their own, both sets of findings effectively document the large scale of the Russian artillery attacks in summer 2014. As described in the previous section, the sheer scale of the attacks makes a manual assessment of each of the many thousands of artillery craters impractical. Furthermore, with firing positions positioned very close to each other in certain areas and with many facing the same direction, identification of the specific firing position responsible for a certain attack is difficult to achieve with certainty.

However, linking individual firing positions with their target sites allows us to map more precisely the specific dates and locations of artillery attacks in summer 2014. To achieve this, the 'automatic' double-matching' procedure - described in the method section - was applied here. Obviously, given the uncertainty of the created trajectory and aiming cones, the method can lead to multiple matches between firing positions and attack sites; i.e. one firing position can be linked to multiple attack sites and vice versa. While it might be possible that such multiple links represent what happened in reality, this may not have been the case for all the links. Therefore, they can only be considered as 'potential' links.

The analysis established links for 133 firing positions and 136 attack sites. As multiple links from a single firing position are possible, 232 potential links between individual firing positions and attack sites were identified. Considering only firing positions with signs of outgoing fire, 64 % (93 of 146⁴⁰) were linked to a specific target. Of the 408 attack sites with identifiable trajectories crossing the border considered in this report, 33 % (136 of 408) are linked to at least one specific firing position.

The average distance between firing positions and linked artillery target sites using this method was approximately 18.4 km, with a minimum of 2.8 km and maximum of 28.7 km. As a comparison, the maximum ranges for relevant artillery systems are shown below. It can be seen that the range of artillery attacks linked in this report is within those of the most common artillery systems used by the forces involved in the 2014 conflict.

The maximum ranges of artillery systems commonly used by Ukrainian and Russian forces. 'SP' = self propelled.

| Artillery system ¹ | 120-mm 2S9 NONA SP mortar | 122-mm 2S1 Gvodzika SP howitzer | 152-mm 2S3 Akatsiya SP howitzer | 122-mm BM-21 GRAD MLRS | 122-mm 2A18 D-30 field howitzer | 152-mm 2A65 Msta-B field howitzer | 152-mm 2S19 Msta-S SP howitzer |
|-------------------------------|---------------------------------|--|--|---------------------------------|--|---|---|
| Maximum range (km) | 8,9 | 15,8 | 18,5 | 20,4 | 21,9 | 28,9 | 29 |

¹ All artillery system ranges are standard ranges (i.e. not extended range projectiles)

We tried to ensure that the linked attacks identified were strongly supported by the available evidence, which also limited the number of possible links that could be identified. Reasons for being unable to confirm potential firing position – artillery target site links include:

- Satellite images of the target sites or the artillery firing position on relevant dates were not available from the sites in consideration.
- The terrain / used weapon systems made it impossible to determine a trajectory from the visible craters. For example, several locations show a large concentration of small artillery craters that we believe indicate the use of

⁴⁰ An aiming trajectory could not be estimated in all cases.

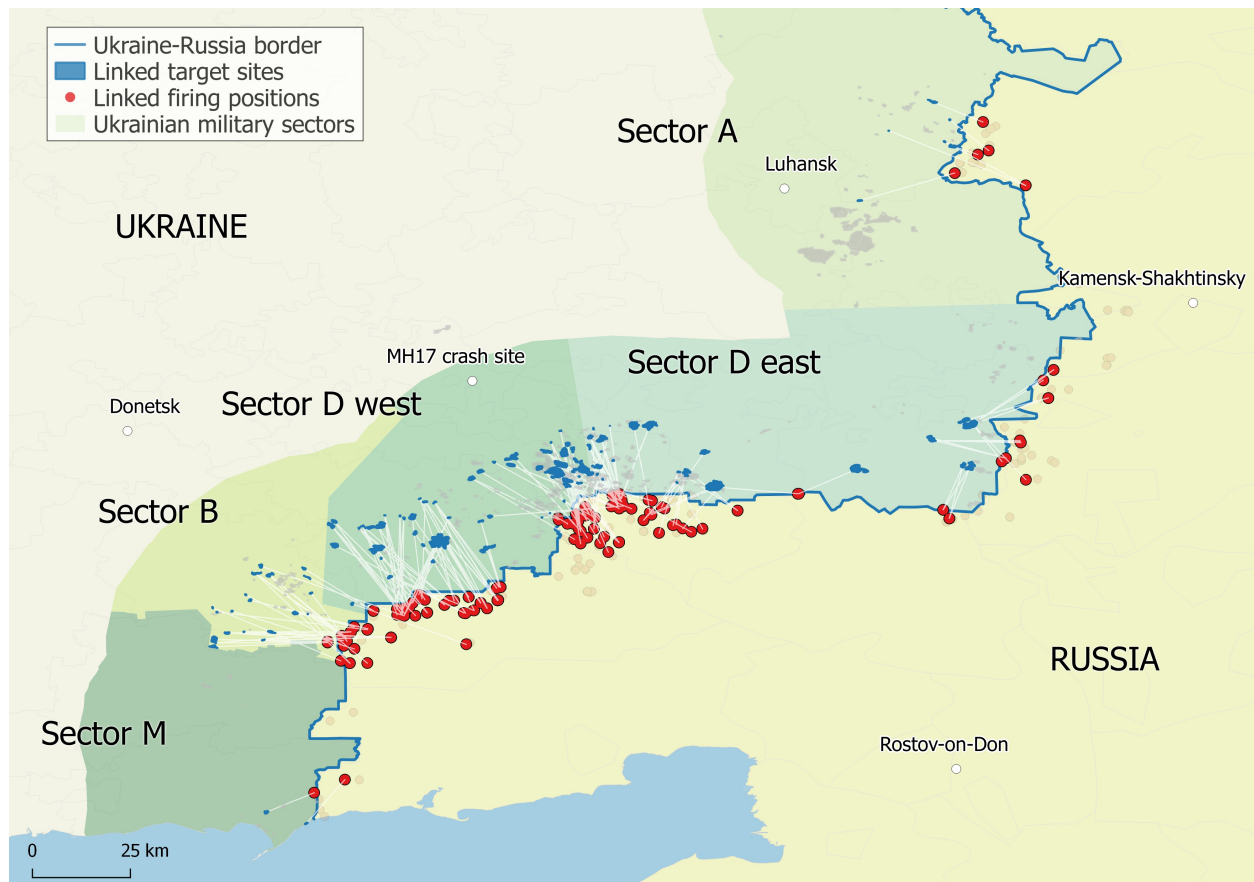
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cluster munitions, which are unfortunately impossible to determine firing trajectories using our method.

- With increased time between the date of an artillery strike and the date of a satellite image, the image of the crater or firing position blast marks become less clear. This made analysis of trajectories / facings impossible to achieve with confidence.
- By analyzing only a small proportion of craters in large target sites, it was possible to miss small deviations in artillery crater trajectory that could indicate fire coming from another firing position.
- Since we could often not determine the type of artillery system used at each firing position with confidence, we did not take into account the possibility that systems with a traversable gun / turret could have been used to fire artillery shells. Instead, we assumed that the artillery unit was used to fire directly forward with a possible deviation of 6 degrees to both sides.

Due to our rigorous method to 'double match' firing positions and target sites using conservative assumptions, we have high confidence that vast majority of the linked attacks we have derived from our analysis occurred as described. With further analysis of individual crater trajectories and firing position facings, we believe that more links between firing positions and attack sites could be identified. However, with 133 matched firing positions and 136 matched target sites, this analysis already strongly supports the main findings of this report – that Russian armed forces frequently targeted Ukrainian units inside Ukraine with artillery attacks.



An overview of the linked attacks considered in this report.

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Discussion / Conclusions

Following the annexation of Crimea in March 2014, the war in Eastern Ukraine began with the seizing of administrative buildings and the de facto control over larger towns and areas in the Donetsk and Luhans'k regions. In contrast to the relatively passive response of the Ukrainian military in Crimea, a more active stance was taken here, and several Ukrainian military brigades, together with volunteer units were deployed to the area by the end of June 2014. A large military operation commenced to regain control over larger parts of the border area in the Donetsk and Luhans'k regions.

The units deployed in the area came under intense artillery fire from early July 2014 onwards and were forced to retreat from their positions in early August. After the retreat from the border area, the Ukrainian army tried to isolate the largest cities in the area: Donetsk and Luhansk. After some initial successes, a series of major Ukrainian defeats in late August 2014 - aided by direct Russian military intervention - led to a complete reversal of this initial gains and further territorial losses.

While the Russian government still insists that the war in Eastern Ukraine is a civil war, the available evidence documents the absolute opposite. Their support has included military equipment and supplies, but also the participation of active Russian servicemen and military units, all of which is now well documented. Given the repeated Russian government denials despite the operation of their servicemen - without identifiable markings - inside Ukraine, the Russian military operation in Eastern Ukraine is considered to be a part of a 'hybrid war'.

This report analyzed one of the most under-reported aspects of Russian military involvement: Russian Armed Forces artillery attacks against Ukraine in summer 2014. In preceding reports it was possible to prove that some attacks occurred, and that these attacks came from inside Russia⁴¹. However, only relatively few attacks could be proven with the available evidence and (time-consuming) methodology.

Building on the preceding reports, the intention of this report is to document the full scale of Russian artillery attacks against Ukrainian forces in summer 2014. The entire border region in the conflict area was searched for potential firing positions or artillery target sites. In total, hundreds of relevant locations were identified. A conservative analytical approach was used to ensure that locations without strong evidence supporting them were not assessed as being involved in cross-border attacks. The main findings can be summarized as follows:

- Artillery units of the Russian Armed Forces fired *at least* on 149 separate occasions attacks against Ukraine in the summer of 2014. 137 of these attacks were launched from positions inside Russia.
- Firing positions left more than 550 traces indicating outgoing fire visible on satellite imagery, of which around 500 are located inside Russia.
- 408 artillery target sites inside Ukraine show a trajectory crossing the Ukrainian-Russian border, 127 of them within 3 kilometers of the borders
- In total, as testified by the number of visible impact craters, thousands of artillery projectiles were fired by the Russian military on targets in Ukraine in the summer of 2014

⁴¹ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>, and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>

The number of attacks and attack sites stated in this report represent estimates of *lower bounds* for the real numbers; the real number of attacks is most likely considerably higher. The stated 149 attacks only encompassed the positions that also show signs of outgoing fire. However, in total 279 likely firing positions that were almost certainly linked to Russian military activities were identified. For a number of attacks (12), Russian military vehicles and 'artillery fire' teams crossed the border into Ukraine and launched attacks from a position inside the country. Furthermore, it can be stated:

- The artillery attacks of the Russian Armed Forces from Russian territory started at the latest at the beginning of July 2014 and escalated in frequency and scale until the signing of the Minsk Protocol in September 2014.
- Cross-border artillery attacks can be found in the entire border area of the conflict zone in the Donetsk and Luhansk regions.
- Cross-border artillery attacks preceded the Russian offensive operations south of Ilovaisk and east of Mariupol.

Using trajectory analysis techniques and a conservative 'double matching' analysis technique we were furthermore able to identify the most likely targets inside Ukraine for 133 firing positions, and for 136 target artillery areas inside Ukraine the most likely source of the artillery fire inside or within 2 kilometers of Russia. Connected attacks can be found along hundreds of kilometers of border in the Donetsk and Luhansk regions, ranging from late June to September.

Due to the frequency, spatial distribution, and scale of the artillery attacks considered in this report, it is impossible to consider these attacks merely as accidents or as the acts of rogue military units. Due to the scale and frequency, they must be considered as acts of aggression and as open acts of war by the Russian Federation against Ukraine.

Given the scale of the Russian attacks, it is not possible to describe all of the firing positions and artillery target sites in the text of this report. Instead, the following 'Case Studies' section gives a brief overview of some noteworthy artillery attacks identified through our analysis. We also invite all readers to access the interactive map⁴² to see for themselves the locations of all of the firing positions and artillery target sites discussed in this report.

We also invite readers to build on the analysis underpinning this report. Further research on this topic could provide a more detailed analysis of the attack sites to distinguish between closely-located attacks and to improve the analysis of artillery target area trajectories. Additionally, a more detailed analysis of the firing positions could determine the specific artillery systems used in the analysis, and a survey of social media and official reports could corroborate our satellite imagery-based findings.

⁴² <https://bellingcatukraine.carto.com/builder/79a5c4ec-c29d-11e6-9676-0e05a8b3e3d7>

Case Studies

Artillery attacks of the Russian army against Ukraine before the downing of Malaysian Airlines Flight 17 (MH17)

In early July, the war in Eastern Ukraine began to increase in intensity. 'Separatist' strongholds like Slovyansk were re-captured by the Ukrainian army and a larger military operation to regain control over the border area was started. A successful Ukrainian operation in the border area would have seriously crippled the support from Russia for the 'separatists' by reducing the inflow of volunteers or 'holiday makers' from Russia.

Soon after the push into the border area, the advance Ukrainian troops came under artillery fire. The area south of Snizhne became particularly important because it was the sole land based supply route for the advance Ukrainian troops. To support their ground troops in the fighting in the area, the Ukrainian Armed Forces also employed close air support jets.

On 17.07.2014, the Malaysian Airlines Flight 17 (MH17) was downed over Eastern Ukraine. Already on the day of the downing, an image appeared in social media which showed a missile trail south-east of Torez. It also became soon obvious that the 'separatists' had control over a Buk missile launcher at this day and that this specific Buk missile launcher was on the move in the same area depicted by the missile trail image on 17.07.2014.

The open source findings⁴³ related to the downing of MH17 have now been largely confirmed by the joint investigation team inquiring the downing of MH17.⁴⁴ It is known that the launch site of the Buk missile that downed MH17 was in a field south of Snizhne in proximity of a 'separatist' block-post. It is further known that the Buk missile launcher responsible for the downing was transported from Russia to the 'separatists' and transported back to Russia after the downing. Available open source evidence furthermore documents the Buk missile launcher in question is from Russia's 53rd Anti-Aircraft Missile Brigade which is based in Kursk.⁴⁵ Even in face of the available evidence, Russian officials still question the above findings and reject Russian involvement in the downing of MH17. An analysis of the Russian military artillery attacks against Ukraine in the days before MH17 was downed could therefore provide valuable insights about the state of open participation of the Russian army in the war.

It has already been established that cross-border artillery attacks from Russia against Ukraine occurred on or before 16.07.2014.⁴⁶ Satellite imagery from 16.07.2014 shows blast marks of a MLRS attack, assessed as coming from five BM-21 Grads that fired at a Ukrainian military camp near Amvrosiivka. Videos uploaded on social media show two different MLRS strikes on 16.07.2014 from a location north of Gukovo, Russia. The blast marks of these two attacks are also later visible in the geolocated field. Impact craters in the area of a Ukrainian military camp near Chervonopartyzans'k point exactly to this launch location. These three attacks clearly originate from a position inside Russia. Additionally, there is no track which leads from the firing position to the Russian-Ukrainian border that could suggest that the vehicles came from Ukraine.

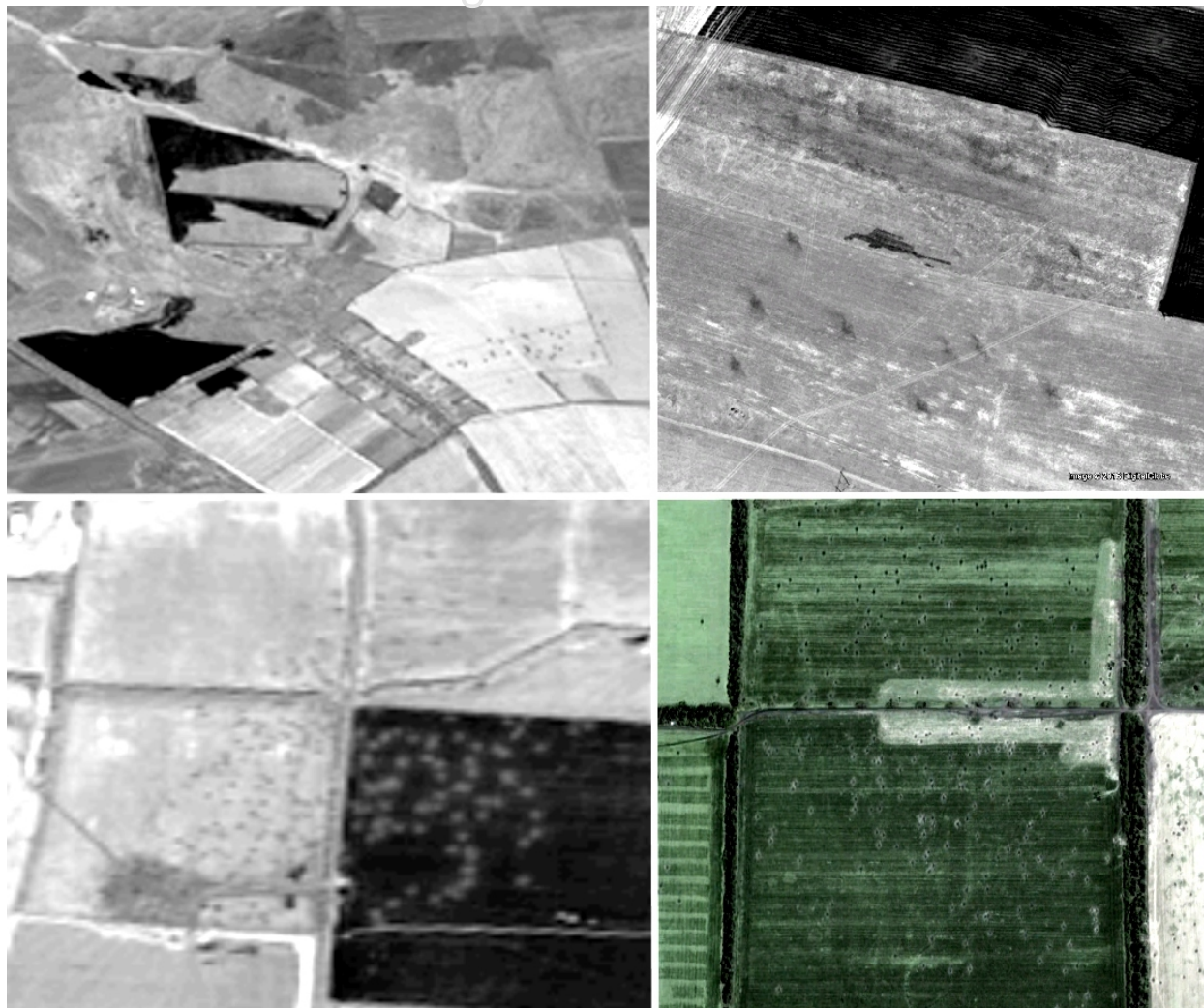
The survey of the border area reveals further firing positions and attack sites. Three further attack sites were described already in the Findings section: one west of Marynivka, and

⁴³ <https://www.bellingcat.com/news/uk-and-europe/2016/07/15/mh17-the-open-source-investigation-two-years-later/>

⁴⁴ <https://www.om.nl/onderwerpen/mh17-crash/>

⁴⁵ https://www.bellingcat.com/news/uk-and-europe/2016/05/03/the_lost_digit/

⁴⁶ <https://www.bellingcat.com/news/uk-and-europe/2015/02/17/origin-of-artillery-attacks/>



Example of attacks sites inside Ukraine, top left: Zelenopillya (47.921419 39.481193), top right: Provallya (48.134724 39.795238) bottom left: Brats'ke (47.929688 39.732268), bottom right: Chervonyi Zhovten' (47.884594 39.146321), all imagery shows the area on 16.07.2014, left column: Digital Globe previews, right column: Google Earth

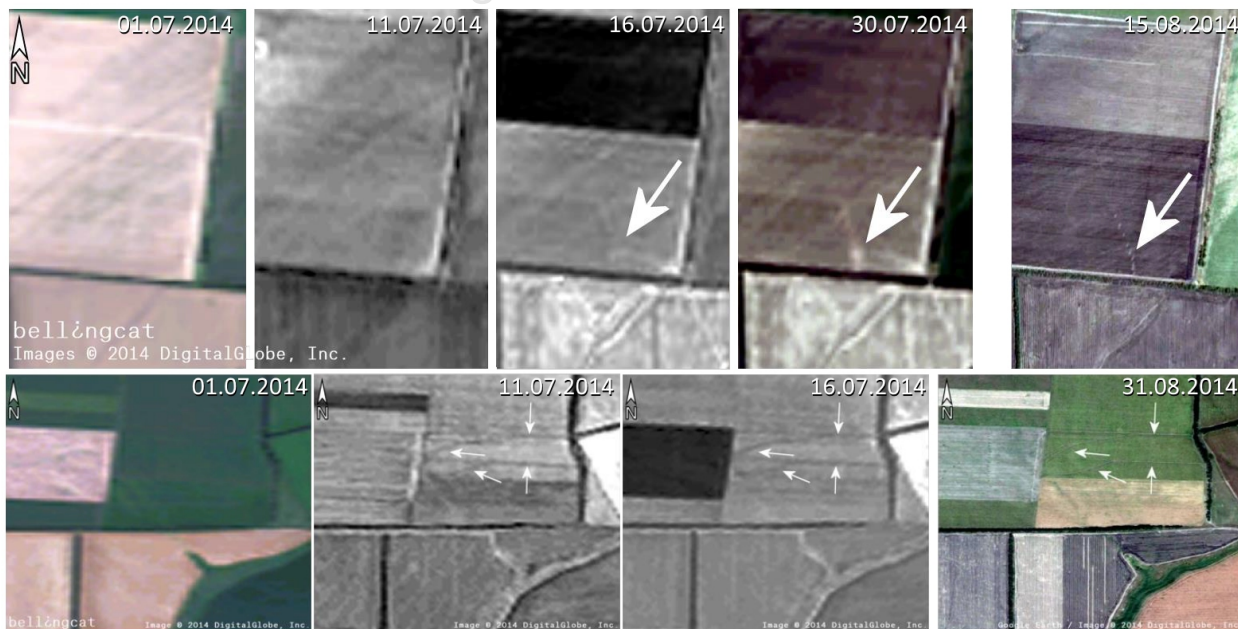
at least two attacks sites at the camp near Brats'ke. The image above shows three additional attack sites, the attack at a Ukrainian camp near Zelenopillya, an attack near Provallya, again the attack near Brats'ke and an attack north of Chervonyi Zhovten'. In all presented cases the trajectory of the craters points toward the Ukrainian-Russian border. In total, 56 attacks sites with a trajectory pointing toward Russia resulting from attacks before 17.07.2014 could be identified.

Moreover, it is possible to find artillery impact craters in the proximity of almost all Ukrainian camps in the border area on satellite imagery from 16.07.2014. In some cases, in particular for the attacks situated in the area of the northern-most Ukrainian camp near Krasnodon, the estimated trajectory suggests a firing position inside Ukraine. However, as the same type of targets were attacked, these attacks are likely part of the strategy directed at damaging or disabling the forward Ukrainian units in the border area. This strategy was eventually successful.

Furthermore, it is possible to identify a number of additional (likely) firing positions. Most of them are inside Ukraine, but are assessed as a Russian military firing position. In case of the well-known attack at the Ukrainian camp near Zelenopillya, the trajectory of the visible craters indicates that the fire came from the south-west.

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Example of three firing positions with signs of outgoing fire inside Ukraine but assessed as Russian artillery fire. Digital Globe preview imagery is used to restrict the possible date, source: Bellingcat investigation "Russia's Path(s) to War"

It is possible to identify a firing position exactly in this direction inside Ukraine, only 200 m away from the Russian border. Also in case of the already mentioned Amvrosiivka attack, a second firing position could be identified. This firing position is inside Ukraine, but again within 1 km of the border. In both cases, there are tracks leading from the firing positions to the Ukrainian-Russian border.

It was not possible to identify additional firing positions with signs of outgoing fire inside Russia in addition to the three attacks already described before the downing of MH17. Inside Ukraine, close to the border, four firing positions with signs of outgoing fire could be identified. In all seven instances, the visible blast marks indicate the usage of MLR systems. However, it was not possible to identify the firing position for all identified attack sites. For example, the origin of the presented attack near Brats'ke visible on 01.07.2014 and the attack near Provalya visible on 16.07.2014 is unknown.

Summarizing the findings for this period, it can be clearly concluded that Russian artillery attacks against Ukraine were not a rare and localized event before the downing of MH17. Attacks can be identified along the entire border area, and in large parts the estimated trajectory points toward the Ukrainian-Russian border. While the larger firing positions are identified inside Ukraine, the proximity of these positions to the border (less than 1 km distance) and the tracks leading to the border strongly suggest Russian artillery fire from these positions. The identified attacks which were clearly launched from inside Russia further support this interpretation. Even more, in one case, it is possible to find a firing position inside Russia and one inside Ukraine that attacked the same target. The table on the next page summarizes the information for the identified firing positions used in the days before the downing of MH17.

These findings also imply that the Russian Armed Forces were already taking an active role in the Ukrainian war before the downing of MH17. The scale and the location of the different firing positions and target areas also precludes an interpretation of the attacks as acts of rogue military commanders in support of the 'separatists' inside Ukraine. There was a clear target selection, Ukrainian camps in the border area, and strategy behind these attacks. The

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| | Category | Number | Number of marks ² | Vehicles visible ³ | Number of vehicles |
|-----------------------------|--|--------|------------------------------|-------------------------------|--------------------|
| Inside Russia | Likely firing positions | 13 | 0 (16) | 3 | 18 |
| | Firing positions with signs of outgoing fire | 3 | 13 (0) | 0 | 0 |
| | Sum | 16 | 13 (16) | 0 | 0 |
| Inside Ukraine ¹ | Likely firing positions | 5 | 0 (26) | 0 | 0 |
| | Firing positions with signs of outgoing fire | 4 | 40 (0) | 0 | 0 |
| | Sum | 9 | 40 (26) | 0 | 0 |
| All | Total Sum | 25 | 53 (42) | 0 | 0 |

¹ within 2 km of Russia, assessed as Russian firing position.

² the first number states the number of traces indicating outgoing fire, the number in brackets indicates other marks (a rough interpretation of this number would be: number of vehicles without clear signs of outgoing fire).

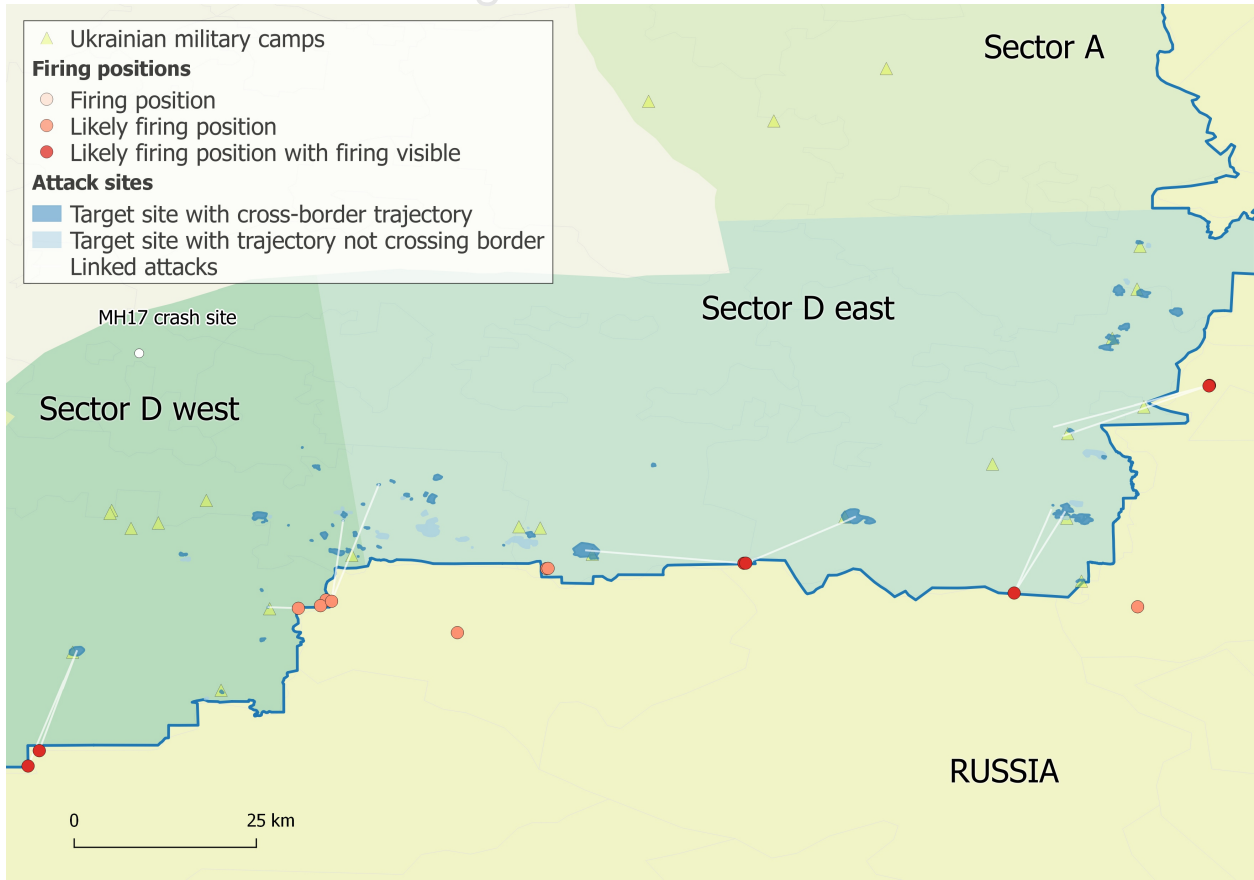
³ Only field howitzers, self-propelled howitzers or MLRS systems are relevant and counted.

active participation of the Russian military at the time before and during the downing of MH17 must therefore also be taken into account while evaluating their role in its destruction.

However, given the number of attacks staged from inside Ukraine, it appears the Russian military attempted to maintain a semblance of plausible deniability in this period. On the other hand, the reason why three attacks were clearly launched from inside Russia is unknown. It is possible that the commander of the artillery battery mistakenly fired from inside Russia while ordered to cross the border before or that the presence of Ukrainian troops made firing from inside Ukraine impossible or too dangerous.

A comparison between the numbers presented above and the numbers for the entire summer period reveals further that this reluctance to fire from inside Russia is a characteristic only for this early phase of Russian artillery attacks in July. Already in late July, most attacks were launched from inside Russia. The reason for this shift is also unknown. One possible cause could be the lack of open condemnation of the first attacks by the international community which reduced the Russian need of a plausible deniability.

On the next page, an overview map showing all the identified firing positions, attacks sites and potential links before the date of the downing of MH17 (17 July) is presented.



Overview over all firing positions and attack sites before 17.07.2014.

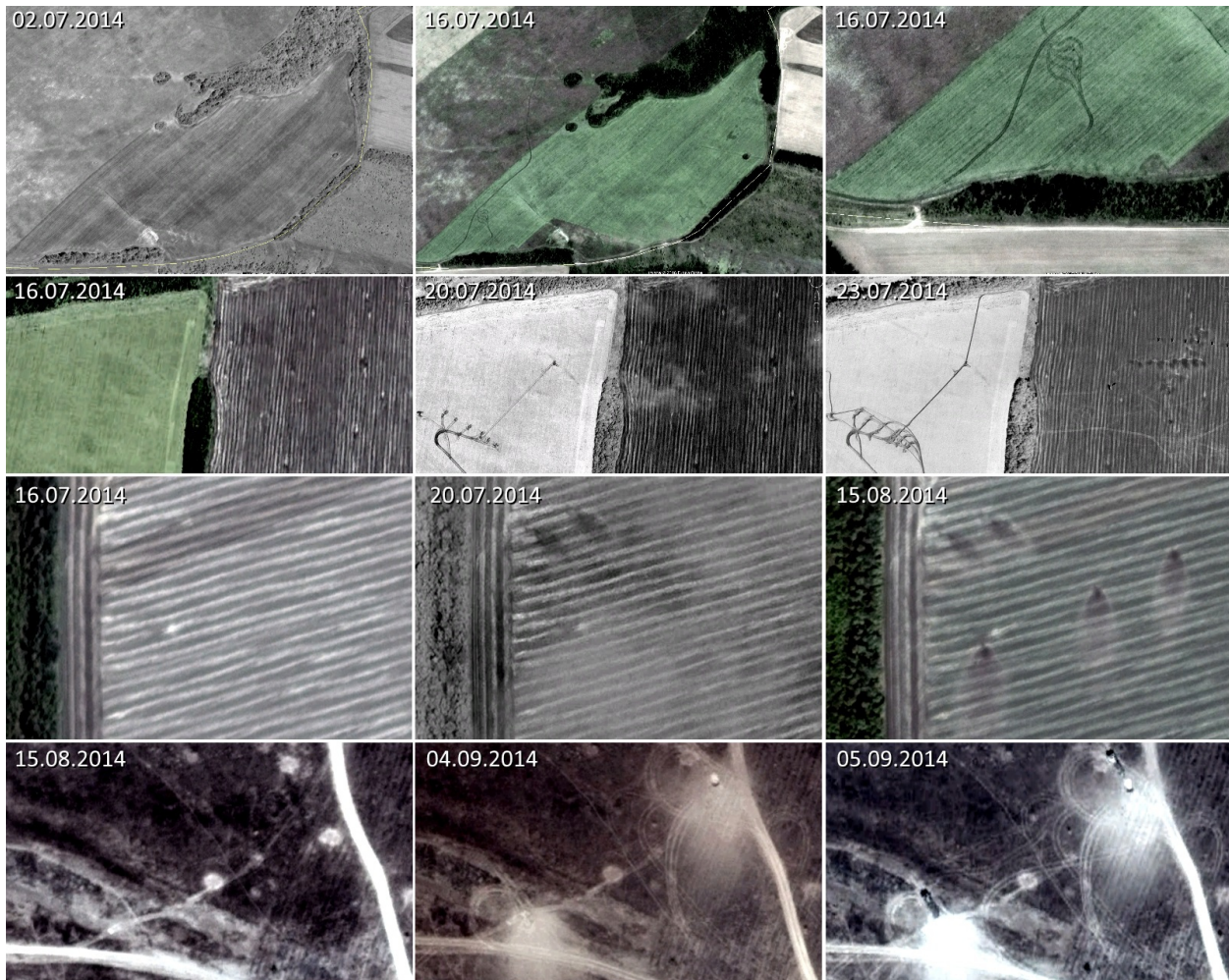
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Artillery attacks from the Kuybyshevo area

The region with the highest density of likely firing positions is the area around Kuybyshevo, Russia. On the other side of the border (inside Ukraine), the area around the strategic important height Savur-Mohyla and the Marynivka-Kuybyshevo border crossing was contested in July and also August 2014. In July, the supply route for the forward Ukrainian army units based the border area led through this contested area. The Marynivka-Kuybyshevo border crossing was captured by the 'separatists' on 14.08.2014.⁴⁷

The preceding case study section already documented that some cross-border attacks had already occurred in this area before 17.07.2014 . It is also possible to identify some likely firing positions in Russia or inside Ukraine less than 2 km from the border in the available 16.07.2014 satellite imagery. Between 16.07.2014 and 26.07.2014, new likely firing positions, mainly identified as field or self-propelled howitzer positions, become visible inside Russia on satellite imagery. Two of them have already been presented in the 'Findings' section of this report. However, it was also possible to identify MLRS blast marks in the area already on 20.07.2014. After 26.07.2014, the satellite imagery coverage of the entire area is less complete. Nevertheless, the many visible firing positions visible on the imagery available to us, shows that the vicinity of Kuybyshevo was used as one of the primary staging areas for cross-border artillery attacks in the summer 2014 conflict.



Examples of a likely firing positions in the Kuybyshevo area, first row: 47.817661 38.823765, second row: 47.796521 39.055886, third row: 47.789273 38.870498, forth row: 47.849985 38.842732

⁴⁷ <https://www.youtube.com/watch?v=oDDkBrkkpl8>

The figure on the preceding page presents four selected areas with likely firing positions in the Kuybyshevo area. The imagery in the first row shows two early likely firing positions, visible for the first time on the 16.07.2014 satellite imagery. One of them is located inside Ukraine, one is inside Russia, but both do not show signs of outgoing fire. The imagery in the last column shows the likely firing position inside Ukraine and the path that the vehicles likely used to cross the border, which is not visible in 02.07.2014 imagery, in this area. A third likely position inside Ukraine is at the end of the visible path leading further to the north.

The second row shows an area with at least three likely firing positions. The 23.07.2014 satellite imagery was presented in summer 2014 by the NATO Supreme Headquarters Allied Powers Europe as evidence for Russian cross-border attacks.⁴⁸ Already, on the 20.07.2014 imagery, six self-propelled howitzers are visible in firing position in this area. In the 23.07.2014 imagery, again six self-propelled howitzers are visible. However, also two crossing lines with marks indicating outgoing fire are visible just south of the howitzers.

The third row shows an area which was used twice as a firing position for MLRS attacks against Ukraine. The first attack, leaving two distinct blast marks, occurred between 16.07.2014 and 20.07.2014. The blast marks indicate outgoing fire in north-westerly direction. On 15.08.2014, three new blast marks are visible in the same area. The attack firing towards the north must have been occurred between 02.08.2014 and 15.08.2014.

The last row shows another location with blast marks indicating outgoing MLRS fire. No such marks are visible on 15.08.2014. In the 04.09.2014 satellite imagery, two large blast marks are clearly visible in the area. Additionally, the 05.09.2014 imagery shows two vehicles in position. Because of their length of approximately 12 m, it can be assessed that the visible vehicles are likely BM-30 Smerch MLRS launchers.

In total, more than one hundred likely firing positions could be identified in the area around Kuybyshevo⁴⁹. The map on the following page shows the development over time. On the left, only likely firing positions which were visible before 17.07.2014 are considered, in the middle, all likely firing positions visible in the available satellite imagery until 03.08.2014 are presented. Note that for large parts of the area east of Ivanovo-Yasinovka no further imagery after 26.07.2014 is available for this period (until 03.08.2014). The right map shows all identified firing positions in the area in the summer of 2014.

The left image showing the early situation (before the downing of MH17) reveals that only a limited number of firing positions could have been identified in the satellite imagery. However, there are already a number of artillery target sites inside Ukraine in proximity of the likely Ukrainian camp near the Marynivka-Kuybyshevo border crossing with trajectories pointing towards the Ukrainian-Russian border. This suggests that a number of cross-border artillery attacks occurred in this period.

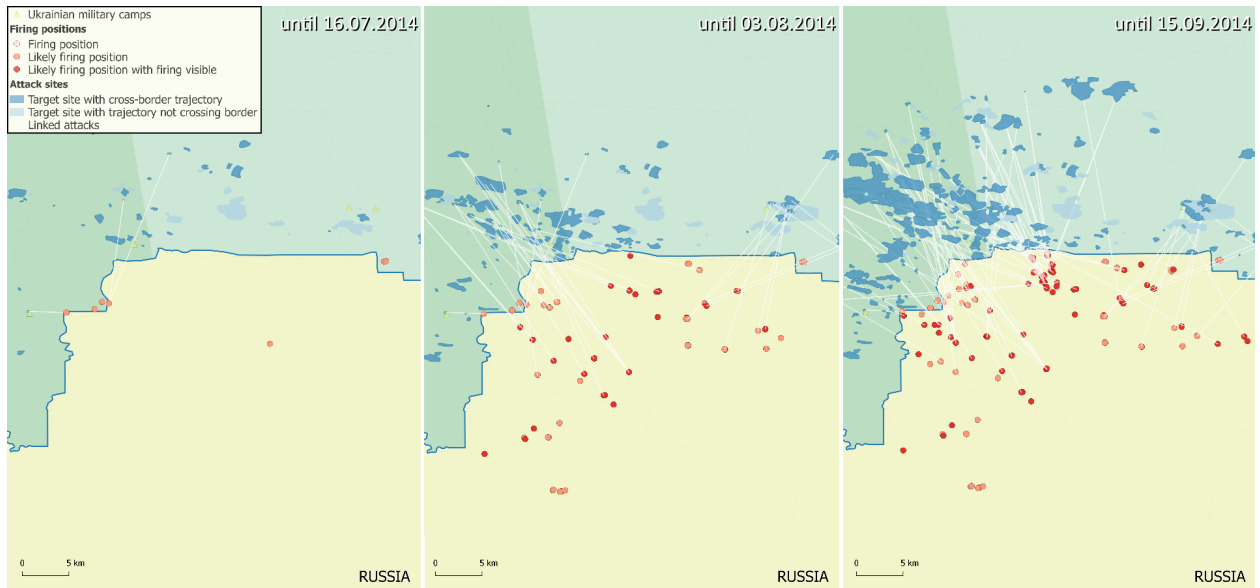
Around two weeks later (by the end of 02 August), a larger number of additional likely firing positions, with and without signs of outgoing fire, are visible. Furthermore, it can be noted that the number of artillery target sites inside Ukraine has been considerably increased. Between the new firing positions and attacks sites a number of potential links could be established (visible in the figure on the following page).

The final map showing the situation at the end of the summer 2014 reveals that further attacks were launched from this area in August and September 2014. A number of new likely

⁴⁸ <http://shape.nato.int/new-satellite-imagery-exposes-russian-combat-troops-inside-ukraine>

⁴⁹ Rectangle with border points: 47.635153 38.747558 and 47.891351 39.134435

firing positions and attacks sites are visible in the satellite imagery. Compared with the situation in early August, a number of these new firing positions are located closer to the Russian-Ukrainian border, and also some of these attacks sites are much deeper inside Ukraine.



Overview over likely firing positions and firing positions with signs of outgoing fire inside Russia or inside Ukraine (< 2 km), attack sites and potential links in the Kuybyshevo area. Displayed are all know positions and attack sites up to the stated date.

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Artillery attacks on a Ukrainian position near Dibrivka

Clear examples of the extent of multiple Russian attacks at certain positions can be seen in artillery attacks on a Ukrainian camp / position near Dibrivka (47.915400 39.077511), and will be presented in more detail. South of this area, attack sites are already visible in some of the earliest imagery from the border area during the conflict on 02.07.2014. The trajectories of these attacks point towards the west-south-west direction, and indicates that Ukrainian artillery attacks targeted locations in this area. It can be assumed that these attacks accompanied or supported the advance in the border area.

The first new attack sites in the area are visible on 20.07.2014. Three separate crater fields are visible. The trajectories of the two eastern fields point approximately in the same direction, the attack site furthest to the west has a different trajectory and is therefore a separate attack. In total, more than 50 craters can be identified. The 23.07.2014 satellite imagery shows multiple new attack sites.

Because of the lack of coverage in the eastern part of the area, it is not possible to clearly



Attack sites near an area with Ukrainian camps / positions near Dibrivka until 23.07.2014; the identified attack sites for each date are marked with a different color. The 20.07.2014 imagery only covers a part of the area, for the missing part the 16.07.2014 imagery is used.



Attack sites near an area of Ukrainian camps / positions near Dibrivka after 23.07.2014; the identified attack site for each date are marked with a different color. The 04.08.2014 imagery only covers a part of the area, for the missing part the 15.08.2014 imagery is used.

state the date for each attack visible in the imagery. It can only be stated that the attacks occurred between 16.07.2014 and 23.07.2014. Roughly two different trajectories for the attack sites in the eastern part of the area can be estimated. Because the estimated trajectory is similar to the one estimated for the 20.07.2014 attack sites, they could be the result of the same attacks. However, also in the western part with the 20.07.2014 imagery, new craters are visible on the 23.07.2014 imagery. Therefore, it can be concluded that the area was also attacked by artillery in between these two dates. For these two attacks sites, two different trajectories indicate two different attacks. In total, far more than 200 additional or new craters become visible in the area.

The 26.07.2014 satellite imagery shows four new attack sites with two different trajectories. The western attack site has a trajectory pointing towards the east-south-east, while the other attacks sites point roughly in a southern direction. More than 50 new craters are visible at this date. The 04.08.2014 and 15.08.2014 satellite images have little difference between them. However, it is possible to identify new craters in the area comparing the satellite images from both dates, which document that there was also an attack after 04.08.2014. But the most intense shelling of the area occurred between 26.07.2014 and 04.08.2014. Two large new

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attack sites can be identified, both covering completely the camp areas. The new attack encompasses far more than 200 new craters. The estimated trajectories from the craters point in two different directions, one attack came from a south-western direction, a second attack from a more southern direction.

In sum, the area was attacked at least nine times between 16.07.2014 and 15.08.2014. Far more than 500 impact craters can be identified in this area alone as a result of these attacks. While some attacks seemingly didn't hit the intended target, some attacks did hit Ukrainian positions with great accuracy.



An attacked Ukrainian position in the area near Dibrivka (47.915020 39.083086), only imagery with new visible craters in the displayed area is presented.

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Russian artillery attacks inside Ukraine in the late August offensive

One type of Russian artillery attack against Ukraine in the summer of 2014 has not yet been taken into account in this report: Russian artillery attacks deep inside Ukraine during the late summer offensive (approximately after 22 August). These artillery attacks were deliberately omitted from the preceding sections, because their location deep inside Ukraine made clear attributions of responsibility for artillery attacks quite difficult. While the following cases are assessed as quite likely Russian artillery firing positions, a definitive attribution of responsibility is not possible in most cases.

After the retreat from the border area in early August, Ukrainian forces changed strategy, and instead tried to isolate the two largest cities in the conflict zone from the border (Donets'k and Luhansk). To achieve this target, Ukrainian troops advanced to encircle the cities. South of Luhansk, the Ukrainian army had regained control over the Luhansk airport in early July. In August 2014, Ukrainian troops advanced as far as neighboring Novosvitlivka and Khryashchuvate,⁵⁰ cutting off the most direct connecting road between Donets'k, Russia, and Luhansk (the E40). East of Donets'k, Ukraine, Ukrainian troops advanced toward Ilovais'k.⁵¹ However, at the end of August, a series of major Ukrainian defeats lead to a complete reversal of these gains and further territorial losses until the signing of the first Minsk Protocol on 05.09.2014 greatly reduced the intensity of the fighting.

Around the same time as these events were taking place, Russia prepared to send a large 'aid-convoy' to the border, a controversy that was widely covered by the international press.⁵² On 22.08.2014, the convoy finally entered Ukraine.⁵³ Before this on 14.08.2014, in the midst of the 'aid-convoy' controversy, the crossing of Russian military vehicles into Ukraine was observed by journalists.⁵⁴ On 28.08.2014, the NATO Supreme Headquarters Allied Powers Europe (NATO SHAPE) published satellite imagery showing self-propelled howitzers near Krasnodon, Ukraine, on 21.08.2014 and 23.08.2014.⁵⁵

It is now known that Russian troops entered Ukraine at multiple places in this phase of the war and participated in several decisive battles in the border area.⁵⁶ The presence of Russian military vehicles and soldiers is documented for the battles near Luhansk⁵⁷, near Ilovais'k⁵⁸ and far to the south near Novoazovs'k⁵⁹. This documented presence in Ukraine, in one case even artillerymen, makes it plausible that a number of artillery attacks in the area were also

⁵⁰ <http://www.bbc.com/news/world-europe-28798246>

⁵¹ <http://www.nbcnews.com/storyline/ukraine-crisis/battles-Donets'k-eastern-ukraine-kill-least-43-n184816>

⁵² <http://www.telegraph.co.uk/news/worldnews/europe/russia/11033326/Russian-aid-convoy-resumes-journey-to-Ukraine.html>

⁵³ <http://www.bbc.com/news/world-europe-28892525>

⁵⁴ <https://www.theguardian.com/world/2014/aug/14/russian-military-vehicles-enter-ukraine-aid-convoy-stops-short-border>

⁵⁵ <http://shape.nato.int/new-satellite-imagery-exposes-russian-combat-troops-inside-ukraine>

⁵⁶ <https://www.bellingcat.com/news/uk-and-europe/2015/09/21/bellingcat-investigation-russias-paths-to-war/> and <https://www.bellingcat.com/news/uk-and-europe/2016/06/15/9629/>

⁵⁷ <https://www.bellingcat.com/news/uk-and-europe/2015/11/13/136-brigade-in-donbass/> and <https://www.bellingcat.com/news/uk-and-europe/2016/01/16/russias-200th-motorized-infantry-brigade-in-the-donbass/>

⁵⁸ <https://www.bellingcat.com/news/uk-and-europe/2015/09/22/russias-6th-tank-brigade/>

⁵⁹ <https://www.bellingcat.com/resources/case-studies/2015/05/29/confirming-the-location-of-the-same-msta-s-in-russia-and-ukraine/> and <https://www.bellingcat.com/news/2015/12/03/the-burning-road-to-mariupol/>



Comparison of self-propelled howitzer used by Ukraine and Russia, selection of most common types, all images via: <http://lostarmour.info>

conducted by the Russian formations fighting in Ukraine. However, this knowledge is only an indirect evidence for a Russian presence at the individual firing positions.

The context of the war should therefore be taken into account while assessing the different military positions visible inside Ukraine on satellite imagery, particularly on images from late August or September. For example, a large number of positions south of Ilovais'k appeared on satellite imagery in between the Russian border and the positions of Ukrainian forces; the possibility of this being made up of local 'separatist' troops is therefore extremely low. The same applies to the area around Novoazovs'k where the attacking force also appeared from locations in between the Russian border and Ukrainian military checkpoints. The area most difficult to assess is the battlefield south of Luhansk. However, the evidence of Russian formations in this area makes it highly plausible that they had also a (decisive) impact on the course of the war in this area.

In some cases, even more direct evidence for the assessment as a Russian firing positions is available. While most types of howitzers and MLR systems used in the war can be found in the inventory of the Ukrainian and Russian army, one type of self-propelled howitzer sticks out. The number of documented captured 2S19 Msta-S self-propelled howitzer from Ukraine is quite low.⁶⁰ Furthermore, the Msta-S is visually distinctive from the other self-propelled howitzer used in the war. Different to a degree which even allows distinguishing it from them in satellite imagery. In the comparison figure above, it is clearly visible that the turret size and the barrel length differs strongly between the Msta-S and the 2S1 Gvozdika, 2S3 Akatsiya, as well 2S5 Giatsint-S. The 2S7 Pion (not included in the comparison above) is too different in size (>10 m vs ~6 m) to be mixed up with a Msta-S, even on satellite imagery.

Therefore, if there is positive identification of a larger (>3) group of Msta-S at a firing position outside of Ukrainian controlled territory, it is almost certainly a Russian military firing position. And a known Russian firing positions strongly increases the likelihood that all other nearby firing positions are also related to the Russian army. The same applies to a lesser degree also

⁶⁰ <http://lostarmour.info/vsu/msta-s/>

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Potential sighting of larger groups of Msta-S inside 'separatist' controlled territory inside Ukraine, left:⁶¹ 23.08.2014 (48.399141 39.619566), middle: 31.08.2014 (39.619566 39.357260), right: 03.09.2014 (47.668316 38.245727)

to video imagery of Msta-S in other areas, such as is available for the area around Novoazovsk.

The imagery above page shows three identified firing positions with vehicles assessed as Msta-S in position. In all three cases the dimension fits to the known size of a Msta-S and the barrel exceeds the chassis in a way it is characteristic for a Msta-S. The left imagery shows an area north-west of Krasnodon on 23.08.2014. The imagery was published by the NATO SHAPE. The complete 23.08.2014 imagery shows two firing positions with eight Msta-S. The traces of the firing positions and signs of outgoing fire are visible in the 31.08.2014 satellite imagery available in Google Earth.

The imagery in the middle shows an area south of the Luhansk airport on 31.08.2014. In total, seven Msta-S are visible at two different positions. Signs of outgoing fire were identified near six of them. In proximity to this position is another firing location showing additional six self-propelled howitzers of a different type in firing positions. The firing location to the right is north-west of Kumachove and shows five Msta-S with traces of outgoing fire in formation on 03.09.2014. With these sightings, it is possible to document the presence of Msta-S's at two different locations south of Luhansk on two different dates and also south of Ilovaisk. Therefore, the presence of Russian artillery units in both areas can be considered to be very likely.

The documented presence of Russian artillerymen in Novosvitlivka after its capture by 'separatist' forces furthermore documents the presence of such forces also in this area. Together with the general reasoning presented above, this information allowed the assessment of firing positions inside Ukraine as likely Russian firing positions. In total, 60 firing positions are classified as Russian fire position inside Ukraine. 49 of them shows signs of outgoing fire, and in 21 cases visible blast marks indicate outgoing MLRS fire. At 15 likely firing positions are artillery vehicles with 72 vehicles in total. The table on the following page summarizes these findings.

⁶¹ <http://shape.nato.int/new-satellite-imagery-exposes-russian-combat-troops-inside-ukraine>

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Overview of likely firing positions, and firing positions with signs of outgoing fire inside Ukraine (> 2 km)

| | Category | Number | Number of marks ² | Vehicles visible ³ | Number of vehicles |
|-----------------------------|--|--------|------------------------------|-------------------------------|--------------------|
| Inside Ukraine ¹ | Likely firing positions | 11 | 0 (39) | 6 | 29 |
| | Firing positions with signs of outgoing fire | 49 | 200 (15) | 9 | 43 |
| | Sum | 60 | 200 (54) | 15 | 72 |

¹ only positions not taken into account so far are considered here, assessed as Russian firing position.

² the first number states the number of traces indicating outgoing fire, the number in brackets indicates other marks (a rough interpretation of this number would be: number of vehicles without clear signs of outgoing fire).

³ Only field howitzers, self-propelled howitzers or MLRS are relevant and counted.

These firing positions are not included in the 279 so far discussed likely firing positions. Combining both numbers leads to 339 identified likely Russian military firing positions in summer 2014. 198 of them show signs of outgoing fire with in total over 760 corresponding marks.

The overview map below shows all identified Russian firing positions inside Ukraine (> 2 km from the border). An identification of potential artillery target sites in these areas was not conducted because target sites out of range of the Russian border were not the focus of this study.



Overview over likely firing positions and those with signs of outgoing fire inside Ukraine (> 2 km).

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