Protected Civilian Infrastructure in El-Fasher Shelled as Zamzam Burns

15 May 2025

Yale SCHOOL OF PUBLIC HEALTH
Humanitarian Research Lab

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I. Key Findings

Artillery Damages Critical Infrastructure and Civilian Neighborhoods in El-Fasher

The Yale School of Public Health's Humanitarian Research Lab (HRL) assesses new damage in Abu Shouk Internally Displaced Persons (IDP) camp and northeastern and central neighborhoods in El-Fasher city visible in satellite imagery between 12 and 15 May 2025. Damage is observed at the Al-Saudi Hospital, the Mawashi (livestock) market, two mosques, and other likely civilian dwellings in El-Fasher and Abu Shouk IDP Camp. The majority of this damage in El-Fasher is consistent with munition impacts from artillery shelling. Sustained and continuous bombardment directly endangers civilians, displaced populations, and critical infrastructure in El-Fasher and its neighboring IDP camps.

These findings corroborate reports of sustained artillery shelling across El-Fasher during this period, as well as reported Rapid Support Forces (RSF) shelling that allegedly killed at least five people in Abu Shouk IDP Camp on 13-14 May 2025.[1] Shelling on 14 May 2025 reportedly damaged a community kitchen and injured five aid workers in the El-Shorfa neighborhood in El-Fasher.[2] UNICEF reported that artillery fire on 13 May 2025 destroyed a UNICEF-supported water truck in the Al-Saudi Hospital compound, "disrupting access to safe water to an estimated 1,000 severely ill hospital patients."[3] Attacks on Al-Saudi Hospital on 12-13 May 2025 reportedly forced some patients to evacuate from the hospital, and *Darfur24* reported on 14 May 2025 that the closure of healthcare facilities in El-Fasher is forcing pregnant women to give birth in potentially life-threatening conditions.[4] The International Organization for Migration (IOM) reported that between 11 and 13 May 2025, an estimated 334 households were displaced from Abu Shouk IDP Camp and El-Fasher due to heightened insecurity.[5]

RSF Arson Attacks and Access Point Control in Zamzam IDP Camp

RSF continued to raze Zamzam IDP Camp after capturing the camp on 16 April 2025. Through analysis of satellite imagery, Yale HRL assesses that more than 0.3 square kilometers of Zamzam IDP Camp were destroyed in likely arson attacks between 16 April and 10 May 2025. This area is equivalent to approximately 4.23 standard FIFA football pitches.[6] An active fire was also observed in satellite imagery of Zamzam between 01 and 04 May 2025. A total of over 2.0 square kilometers of the camp (equivalent to approximately 28.17 standard FIFA football pitches) have been destroyed between 10 April and 10 May 2025. The thermal scarring observed between 10 and 16 April 2025 was concentrated around the main market and roads in central Zamzam, while the thermal scarring observed between 16 April and 10 May 2025 is dispersed throughout the camp. These findings are consistent with reports that RSF conducted widespread looting and burning of individual homes in Zamzam.[7]

Yale HRL also identifies likely RSF technical vehicles encircling Zamzam IDP Camp, controlling access into and out of the camp in satellite imagery from 7 May 2025. According to UNICEF, approximately 180,000 people remained trapped in Zamzam Camp as of 2 May 2025.[8] Local news organizations reported that those that RSF trapped in the IDP camp have been subject to repeated looting, attacks, conflict-

related sexual violence (CRSV), and extrajudicial detentions.[9] The population of Zamzam IDP Camp was estimated to be as high as 600,000 people prior to RSF's attack and capture of the IDP camp. An estimated 406,300 people, many on foot, have fled from Zamzam following RSF's capture of the camp.[10]

II. Methodology

Yale HRL utilizes data fusion methodologies of open source and remote sensing data analysis. Yale HRL produced this report through the cross-corroboration of open source data, including social media, local news reporting, multimedia, and other reports, and remote sensing data, including satellite imagery and thermal sensor data. Researchers analyzed open source data across social media, news reports, and other publicly available sources to identify, chrono- and geolocate, and verify incidents. Analysts assess the credibility and reliability of open source data based on a source's level of detail, past credibility, and the corroboration of other independent sources. Remote sensing and satellite imagery analysis relies on multi-temporal change detection, which involves the comparison of two or more satellite images of the same area captured at different times to detect differences in coloration, visual properties, and presence, absence, or positional change of objects across the images.

The map of fire damage in Zamzam IDP Camp was produced using a Burned Area Index in Google Earth Engine with Copernicus Sentinel-2 Imagery methodology outlined by Chuvieco et al.[11] Sentinel-2 images were loaded into Google Earth Engine where imagery for baseline and post-damage were selected. For each image, a Burned Area Index (BAI) was applied, which uses Red and Near-Infrared bands to calculate an index depicting burned area. The baseline image was subtracted from the post damage image to get the change between images. A BAI change threshold of 10 or greater was applied to depict likely burned areas that were not previously present in the baseline image.[12]

Limitations

There are significant limitations to the data fusion methodology. The information environment in Sudan does not have the breadth of data available in other locations and there is likely a significant reporting bias for those who provide open source reporting. The tools and techniques present significant challenges to assess activities such as extrajudicial detention, conflict-related sexual violence (CRSV), and conflict-related casualties, particularly in environments with limited data. Satellite imagery analysis is limited by available imagery over time and space. Available nadir angles of satellite imagery can produce challenges to assess structural damage, until multiple angles and ground-level photographic and video materials emerge to help inform the analysis. Image resolution level can also limit the analyst's ability to perceive the full extent of damage present.

[1] Radio Dabanga, "قتلى وجرحى جراء تجدد القصف المدفعي في الفاشر.. واليونسيف تكشف عن تدمير شاحنة مياه" May 14, 2025, https://www.dabangasudan.org/ar/all-news/article/%D9%82%D8%AA%D9%84%D9%89-%D9%88%D8%AC%D8%B1%D8%AD%D9%89-%D8%AC%D8%B1%D8%A7%D8%A1-%D8%AA%D8%AC%D8%AF%D8%AF-%D8%A7%D9%84%D9%82%D8%B5%D9%81-%D8%A7%D9%84%D9%85%D8%AF%D9%81%D8%B9%D9%8A-%D9%81%D9%8A-%D8%A7, archived at https://perma.cc/PK33-FLPH; Sudan Tribune, "تدهور مريع للوضع الإنساني والمعيشي في الفاشر وسط نزوح مستمر" May 13, 2025, https://sudantribune.net/article300831/, archived at https://perma.cc/CC4Y-NQ78; Al-Quds Al-Arabi, "الجيش السوداني يعلن مقتل7 مدنيين بقصف "للدعم السريع" على الفاشر" May 12, 2025, https://www.alquds.co.uk/%D8%A7%D9%84%D8%AC%D9%8A%D8%B4-%D8%A7%D9%84%D8%B3%D9%88%D8%AF%D8%A7%D9%86%D9%8A-%D9%8A%D8%B9%D9%84%D9%86-%D9%85%D9%82%D8%AA%D9%847-%D9%85%D8%AF%D9%86%D9%8A%D9%8A%D9%86-%D8%A8%D9%82%D8%B5%D9%81/, archived at https://archive.ph/biFm0; Radio Dabanga, "الفاشر: قتلى وجرحى جراء استمرار القصف وتدهور انساني مريع" May 13, 2025, https://www.dabangasudan.org/ar/all-news/article/%D8%A7%D9%84%D9%81%D8%A7%D8%B4%D8%B1-%D9%82%D8%AA%D9%84%D9%89-%D9%88%D8%AC%D8%B1%D8%AD%D9%89-%D8%AC%D8%B1%D8%A7%D8%A1-%D8%A7%D8%B3%D8%AA%D9%85%D8%B1%D8%A7%D8%B1-%D8%A7%D9%84%D9%82%D8%B5%D9%81-%D9%88, archived at https://perma.cc/587T-F6Z6; HRL_MMC_097 and HRL_MMC_098 have been redacted for security reasons.

[2] HRL_MMC_099 has been redacted for security reasons

[3] UNICEF Sudan (@UNICEFSudan), "#NotATarget" X (formerly known as Twitter), May 14, 2025, https://x.com/UNICEFSudan/status/1922636525881184501, archived at https://perma.cc/3V7L-7EVD

[4] Darfur24, " النساء الحوامل بـ"الفاشر" يواجهن الموت بعد توقف المستشفيات" May 14, 2025, https://www.darfur24.com/2025/05/14/%d8%a7%d9%84%d9%86%d8%b3%d8%a7%d8%a1-%d8%a7%d9%84%d8%ad%d9%88%d8%a7%d9%85%d9%84-%d8%a8%d9%80%d8%a7%d9%84%d9%81%d8%a7%d8%b4%d8%b1-%d9%8a%d9%88%d8%a7%d8%ac%d9%87%d9%86-%d8%a7%d9%84%d9%85%d9%88%d8%aa/, archived at https://perma.cc/4NYC-Z9MH

[5] International Organization for Migration, "DTM Sudan Flash Alert: Al Fasher (Al Fasher town), North Darfur," Update 81, May 14, 2025, https://mailchi.mp/iom/dtm-sudan-flash-alert-al-fasher-al-fasher-town-north-darfur-update-081, archived at https://perma.cc/7DPN-7AJG

[6] The definition of football pitches aligns with the FIFA standard football pitches. FIFA recommends a dimension of 105 meters x 68 meters, an area equivalent to 0.071 kilometers squared. FIFA, "5.3: Pitch Dimensions and Surrounding Areas," 2021, https://publications.fifa.com/de/football-stadiums-guidelines/technical-guideline/stadium-guidelines/pitch-dimensions-and-surrounding-areas/, archived at https://perma.cc/CD4C-GSHV

[7] Médecins Sans Frontières, "People fleeing Zamzam camp arrive to overwhelmed humanitarian response in Tawila," May 6, 2025, https://www.msf.org/people-fleeing-zamzam-camp-arrive-overwhelmed-humanitarian-response-tawila, archived at https://perma.cc/TV6M-CWMQ; Médecins Sans Frontières, "Sudan: Desperation as hundreds of thousands flee Zamzam camp," April 18, 2025, https://www.doctorswithoutborders.org/latest/sudan-desperation-hundreds-thousands-flee-zamzam-camp, archived at https://perma.cc/8XWD-J7MS

[8] UN OCHA, "Sudan: Displacement from Zamzam camp, North Darfur State - Flash Update No. 3 (As of 2 May 2025)," May 2, 2025, https://www.unocha.org/publications/report/sudan/sudan-displacement-zamzam-camp-north-darfur-state-flash-update-no-3-2-may-2025, archived at

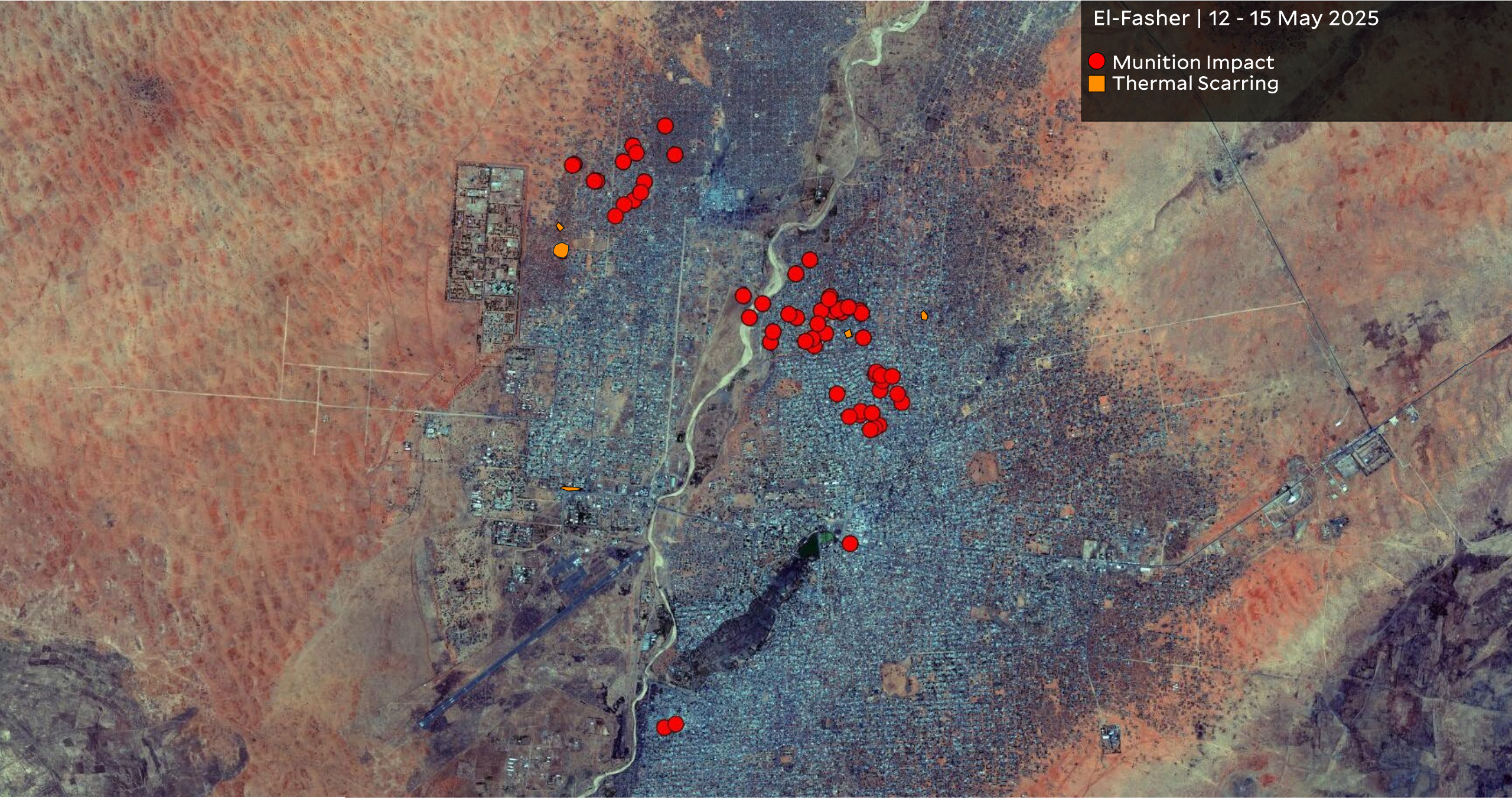
https://perma.cc/9NZS-A5ZE; Sudan Tribune, “ متحدث: مئات الجثث في طرق ومنازل «زمزم» لم تُدفن رغم مرور ثلاثة أسابيع” May 4, 2025, https://sudantribune.net/article300483/, archived at https://perma.cc/Q9QP

[9] UN OCHA, “Sudan: Displacement from Zamzam camp, North Darfur State - Flash Update No. 3 (As of 2 May 2025),” May 2, 2025, https://www.unocha.org/publications/report/sudan/sudan-displacement-zamzam-camp-north-darfur-state-flash-update-no-3-2-may-2025, archived at https://perma.cc/9NZS-A5ZE; https://www.darfur24.com/2025/05/10/%d8%a3%d9%88%d8%b6%d8%a7%d8%b9-%d8%a7%d9%84%d8%b9%d8%a7%d9%84%d9%82%d9%8a%d9%86-%d9%81%d9%8a-%d9%85%d8%ae%d9%8a%d9%85-%d8%b2%d9%85%d8%b2%d9%85-%d8%a8%d8%b4%d9%85%d8%a7%d9%84-%d8%af%d8%a7%d8%b1%d9%81/, archived at https://perma.cc/Q2GF-3QH3; Sudan Tribune, ” متحدث: مئات الجثث في طرق ومنازل «زمزم» لم تُدفن رغم مرور ثلاثة أسابيع” May 4, 2025, https://sudantribune.net/article300483/, archived at https://perma.cc/Q9QP-LEMH; Mohamed Zakaria, ” توثيق ذاتي لمفقودي جرائم الدعم السريع بمخيم زمزم” *Al Jazeera*, May 11, 2025, https://www.aljazeera.net/politics/2025/5/11/%D8%AA%D9%88%D8%AB%D9%8A%D9%82-%D8%B0%D8%A7%D8%AA%D9%8A-%D9%84%D9%85%D9%81%D9%82%D9%88%D8%AF%D9%8A-%D8%AC%D8%B1%D8%A7%D8%A6%D9%85-%D8%A7%D9%84%D8%AF%D8%B9%D9%85-%D8%A7%D9%84%D8%B3%D8%B1%D9%8A%D8%B9, archived at https://perma.cc/68SV-UPRW; Sudan Tribune, ” منصة إلكترونية لتحديث سجل ضحايا انتهاكات «الدعم السريع» في «زمزم»” May 9, 2025, https://sudantribune.net/article300687/, archived at https://perma.cc/5DUQ-LEBE

[10] Caitlin N. Howarth, Kaveh Khoshnood, Nathaniel A. Raymond et al. “Human Security Emergency: Large-Scale Displacement of Civilians on Foot and Animal-Drawn Carts from Zamzam IDP Camp.” 22 April 2025. Humanitarian Research Lab at Yale School of Public Health: New Haven; Médecins Sans Frontières, “Sudan: Desperation as hundreds of thousands flee Zamzam camp,” April 18, 2025, https://www.doctorswithoutborders.org/latest/sudan-desperation-hundreds-thousands-flee-zamzam-camp, archived at https://perma.cc/8XWD-J7MS; UN OCHA, “Sudan: Displacement from Zamzam camp, North Darfur State - Flash Update No. 3 (As of 2 May 2025),” May 2, 2025, https://www.unocha.org/publications/report/sudan/sudan-displacement-zamzam-camp-north-darfur-state-flash-update-no-3-2-may-2025, archived at https://perma.cc/9NZS-A5ZE

[11] Chuvieco, Emilio & Mart, M & Palacios-Orueta, Alicia. (2002). Assessment of different spectral indices in the red-near-infrared spectral domain for burned land discrimination. int. j. remote sensing. 23. 5103-5110. 10.1080/01431160210153129, https://www.researchgate.net/publication/228788017_Assessment_of_different_spectral_indices_in_the_red-near-infrared_spectral_domain_for_burned_land_discrimination

[12] Chuvieco, Emilio & Mart, M & Palacios-Orueta, Alicia. (2002). Assessment of different spectral indices in the red-near-infrared spectral domain for burned land discrimination. int. j. remote sensing. 23. 5103-5110. 10.1080/01431160210153129, https://www.researchgate.net/publication/228788017_Assessment_of_different_spectral_indices_in_the_red-near-infrared_spectral_domain_for_burned_land_discrimination



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Al-Saudi Hospital, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows signatures of thermal scarring and damage to several structures located in the southern sector of the Al-Saudi Hospital.

Similar thermal scarring and damage is observed affecting nearby buildings located east of the hospital.

12 May 2025 © 2025 Maxar, USG-Plus

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Mawashi Market, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to several structures within the Mawashi Market.

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Mawashi Market, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to several structures within the Mawashi Market.

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Victory Mosque, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to the Victory Mosque in central El-Fasher.

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Mosque, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to a mosque and nearby structures in central El-Fasher.

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Abu Shouk IDP Camp, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to several structures within the Abu Shouk IDP Camp.

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Abu Shouk IDP Camp, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows damage from likely shelling to several structures within the Abu Shouk IDP Camp.

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Abu Shouk IDP Camp, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows signatures of thermal scarring and damage to several structures within the Abu Shouk IDP Camp.

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Abu Shouk IDP Camp, El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows signatures of thermal scarring and damage to several structures within the Abu Shouk IDP Camp.

12 May 2025 © 2025 Maxar, USG-Plus

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Central El-Fasher

CONFLICT-RELATED DAMAGE OBSERVED BETWEEN 12-15 MAY 2025

Analysis of satellite imagery collected between 12 and 15 May 2025 over El-Fasher shows signatures of thermal scarring and damage to several structures within the central part of the city.

12 May 2025 © 2025 Maxar, USG-Plus

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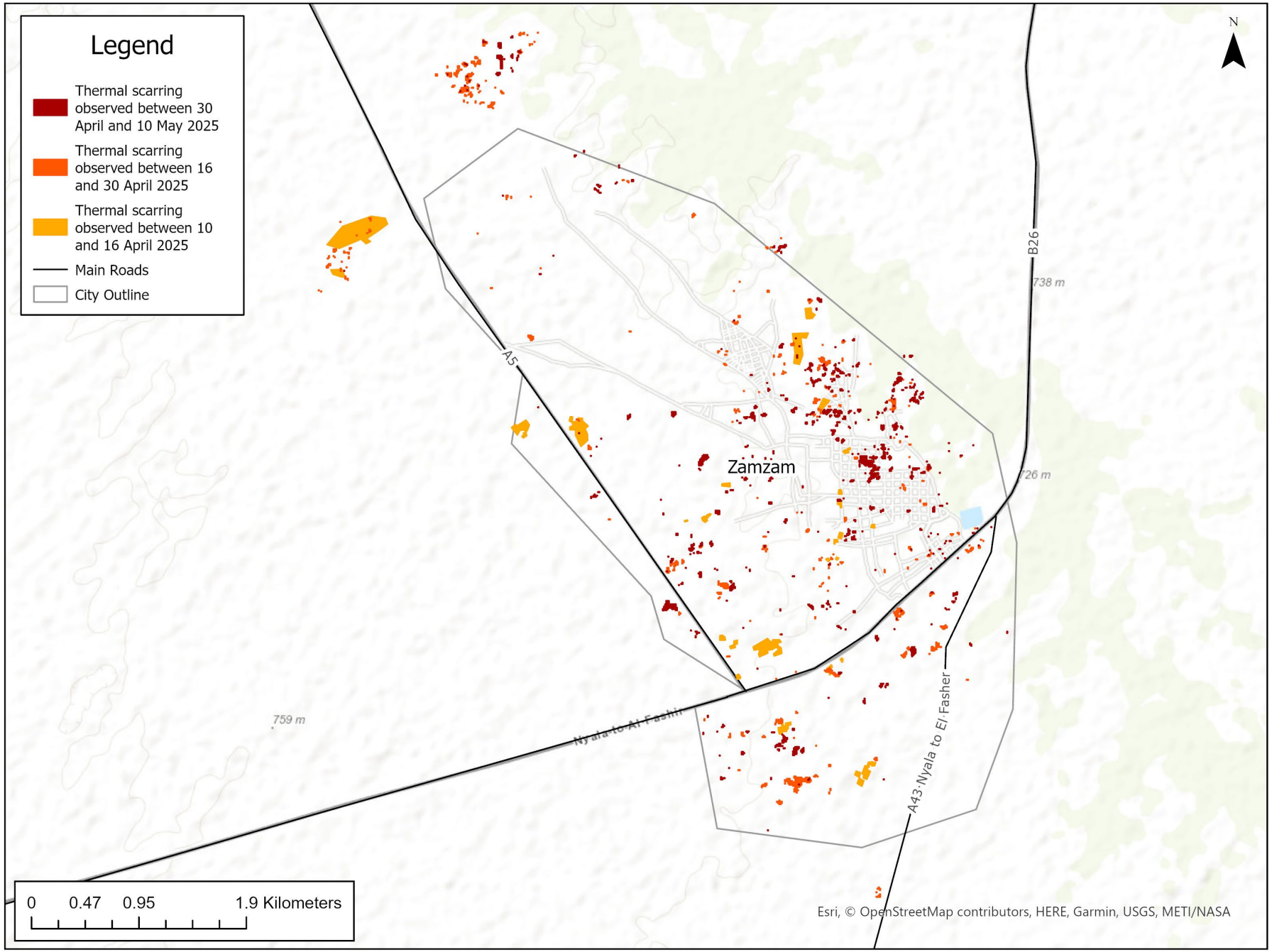
Thermal Scarring observed in Zamzam between 10 April and 10 May 2025

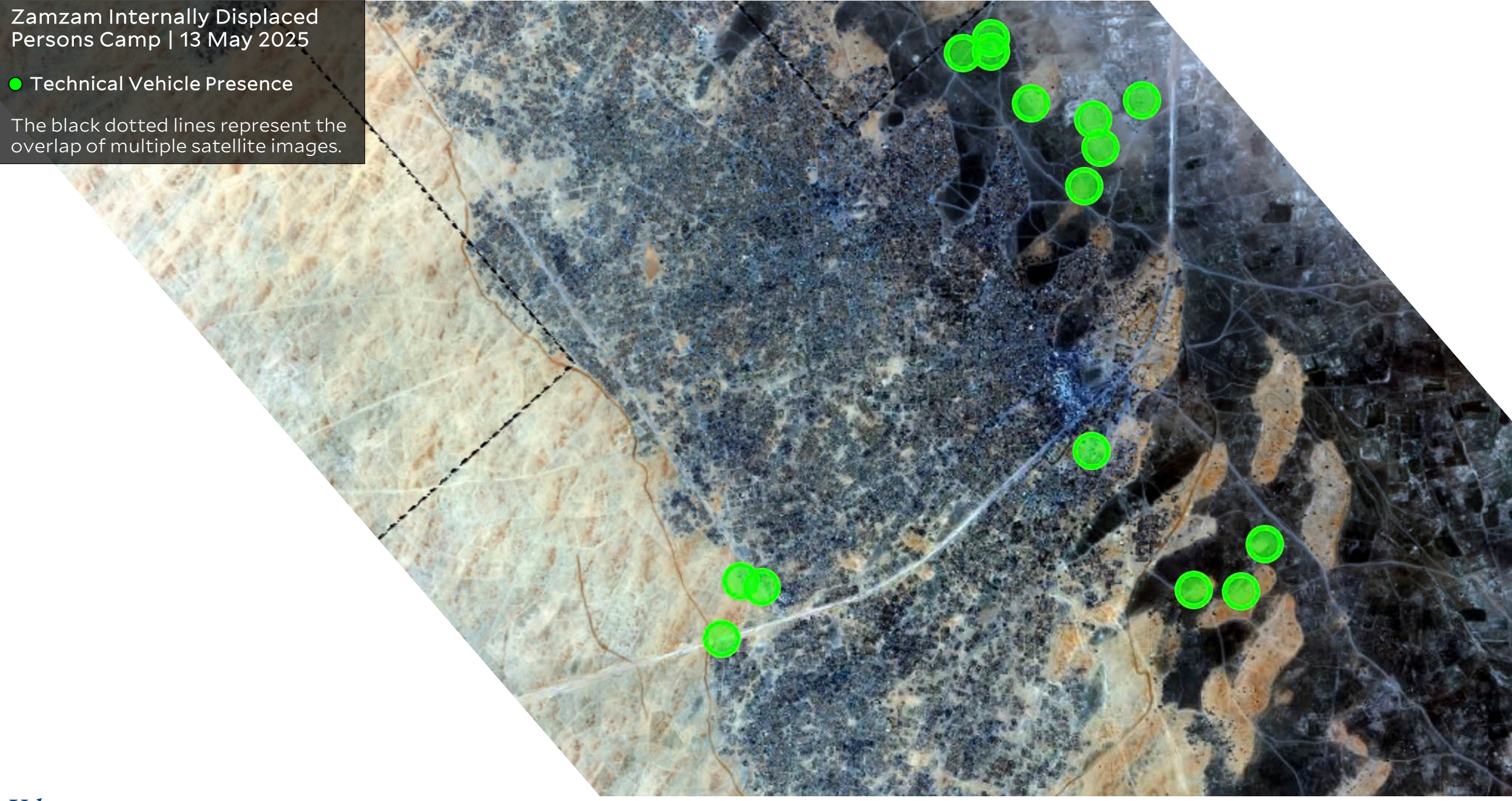


Map utilizes data from Copernicus Sentinel-2 Satellite. Analysis by Yale HRL.

Zamzam Internally Displaced Persons Camp | 13 May 2025

- Technical Vehicle Presence

The black dotted lines represent the overlap of multiple satellite images.



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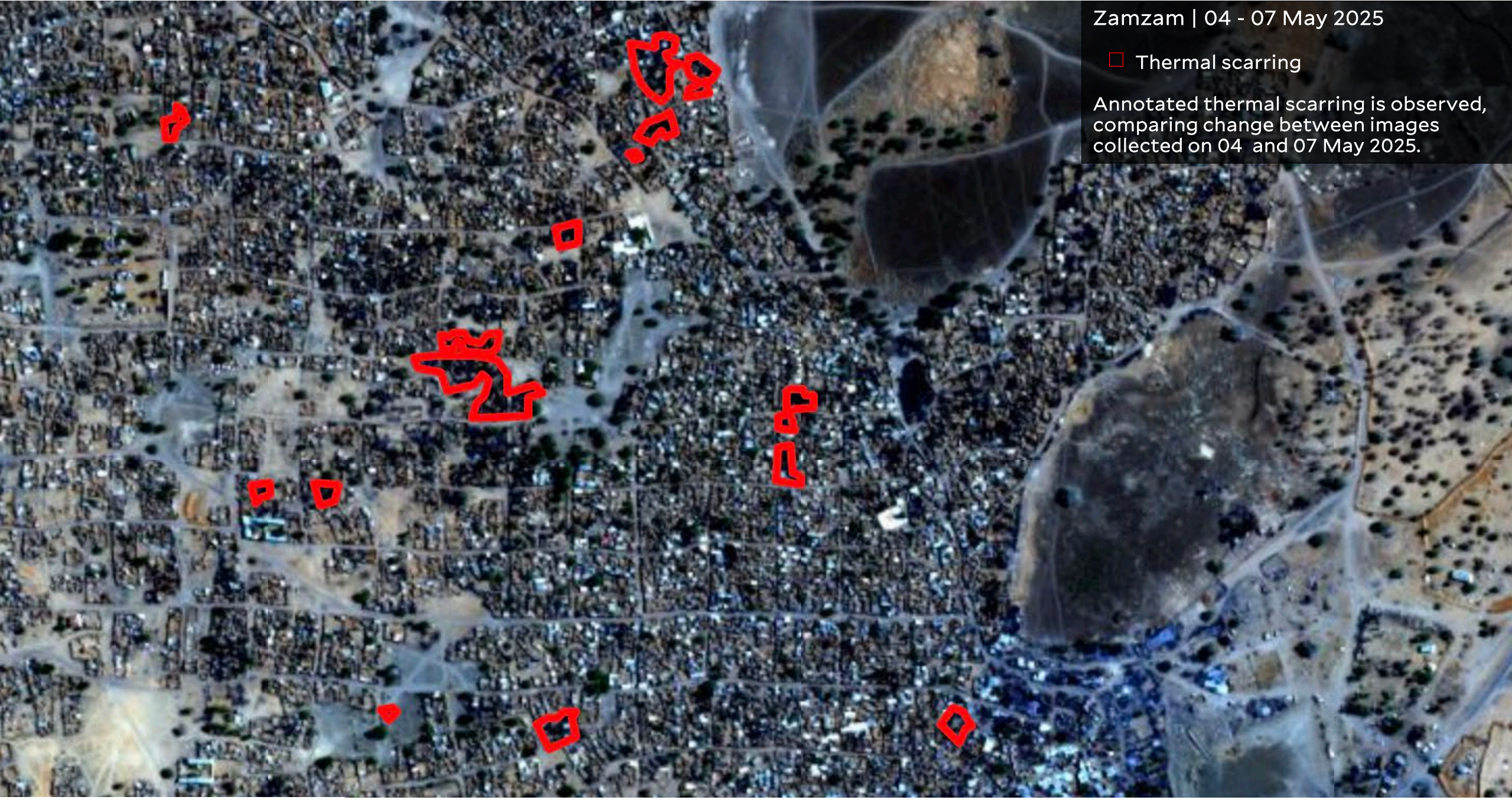

Zamzam IDP Camp

ACTIVE FIRE OBSERVED BETWEEN 01 AND 04 MAY 2025

Analysis of satellite imagery collected between 01 and 04 May 2025 shows active fire and smoke at Zamzam.

There is haze or a weather phenomena in imagery from 4 May 2025.

01 May 2025 © 2025 Planet PBC, USG-Plus

04 May 2025 © 2025 Planet PBC, USG-Plus

Zamzam IDP Camp

THERMAL SCARRING OBSERVED BETWEEN 01 AND 04 MAY 2025

Analysis of satellite imagery collected between 01 and 04 May 2025 shows thermal scarring at Zamzam IDP Camp.

There is haze or a weather phenomena in imagery from 4 May 2025.

01 May 2025 © 2025 Planet PBC, USG-Plus

04 May 2025 © 2025 Planet PBC, USG-Plus

Zamzam IDP Camp

THERMAL SCARRING OBSERVED BETWEEN 01 AND 04 MAY 2025

Analysis of satellite imagery collected between 01 and 04 May 2025 shows thermal scarring at Zamzam IDP Camp.

There is haze or a weather phenomena in imagery from 4 May 2025.

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