



United Nations Institute
for Training and Research



UNOSAT

Impact of the 2014 Conflict in the Gaza Strip

UNOSAT Satellite Derived
Geospatial Analysis

An aerial satellite image of a city, likely Gaza, with a grid overlay. The image shows a dense urban area with buildings and roads. Small colored squares (red, yellow, green) are scattered across the image, marking specific locations. The grid lines are thin and light-colored.

Contributors

Narjess Saidane

Support Team

Carolina Jorda, Celia Navarro, Einar Bjørge, Francesco Pisano, Harry Kendall, Lars Bromley, Manuel Fiol, Olivier van Damme, Robert Wilson, Samir Belabbes, Vanessa Guglielmi, Wendi Pedersen.

The report has been produced with the kind contribution of the Government of Denmark.

Disclaimer

The views expressed in this publication are not necessarily those of the United Nations Institute for Training and Research (UNITAR). The presentations and the designations employed do not imply the expression of any opinion whatsoever on the part of the cooperating divisions concerning the legal status of any country, territory, city or area or of its authorities, or of the delineation of its frontiers or boundaries. Mention of a commercial company or product in this report does not imply endorsement by UNITAR.

UNOSAT is a program of the United Nations Institute for Training and Research (UNITAR), providing satellite imagery and related geographic information, research and analysis to UN humanitarian and development agencies, their implementing partners and Member States

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. UNITAR would appreciate receiving a copy of any material that uses this publication as a source.

This work by UNITAR/UNOSAT is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License.

Copyright © United Nations Institute for Training and Research (UNITAR), 2014.

6 METHODOLOGY

**8 DAMAGE
ASSESSMENT**

**BUILDINGS, STRUCTURES
& CRATERS**

**12 HEALTH
FACILITIES**

**14 EDUCATIONAL
FACILITIES**

**18 AGRICULTURAL
FACILITIES**

22 2009-2014

**DAMAGE
COMPARISON**

24 CONCLUSIONS

PREFACE

During the summer of 2014, a devastating conflict again took place in the Gaza Strip and surrounding Israeli territories. Operation Protective Edge was launched on 8 July by the Israeli Defence Forces in response to rocket fire from the Gaza Strip into Israel. The conflict lasted for 50 days, until 26 August, when an open-ended cease fire came into effect and was respected. The United Nations and Palestinian Authorities were providing humanitarian aid to the affected civilian population in the Gaza Strip, in particular to those whose homes had been destroyed or those who lived in neighbourhoods likely to be affected by attacks from ground or air forces.

The United Nations Development Programme (UNDP) contacted UNITAR's Operational Satellite Applications Programme (UNOSAT) to assist with damage assessments during and after the conflict. UNOSAT's Rapid Mapping service worked closely with the UNDP Crisis Response Unit and the UNDP Programme for Assistance to the Palestinian People (PAPP). Close coordination and collaboration also took place with the UN Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), the UN Office for the Coordination of Humanitarian Affairs (UN OCHA) in Jerusalem and the International Committee of the Red Cross (ICRC). As an example, UNOSAT sent a representative to Jerusalem and Gaza in preparation for the study presented here and to learn how the results can best contribute to the forthcoming reconstruction efforts.

The use of satellite imagery has now become the norm during humanitarian crises. This technology provides information over areas not possible to assess due to security restrictions or simply logistical challenges. This was also the case when UNOSAT's Rapid Mapping service was activated for the Gaza Strip. Our standard damage assessment methodology was applied using commercially available high resolution satellite imagery analysed by a team of experts in Geneva. Analysis results were provided to sister agencies and made available online for download from our public website as soon as they were ready.

The study published here takes as input the results from our Rapid Mapping service and looks at the geo-spatial distribution of damage, as well as overall statistics for what has been observed using the imagery. The findings are fully objective as they are based solely on scientific imagery analysis and not reports from any of the conflicting sides, nor third party information.

In addition to the results presented in this study, UNOSAT is currently working with UNDP PAPP, Palestinian Authorities, UNRWA and UN OCHA to provide our results in data and map formats for input to the planning, execution and analysis of the field based damage assessment. By combining the field assessment with our remote imagery assessment, the complete picture can be drawn. While field assessments cannot cover all damaged buildings during and immediately after the conflict, which UNOSAT assessment has, our remote assessment cannot detect damage not visible from above, such as holes in walls, destroyed windows etc. The two methods are thus complementary both in time and in level of assessment detail.

The findings presented here provide key information for the upcoming donor conference to be held in Cairo co-hosted by Egypt and Norway.

Geneva, 30 September 2014

Einar Bjørgo
Manager, UNOSAT

The report has been produced
with the kind contribution of
the Government of Denmark.

FOREWORD

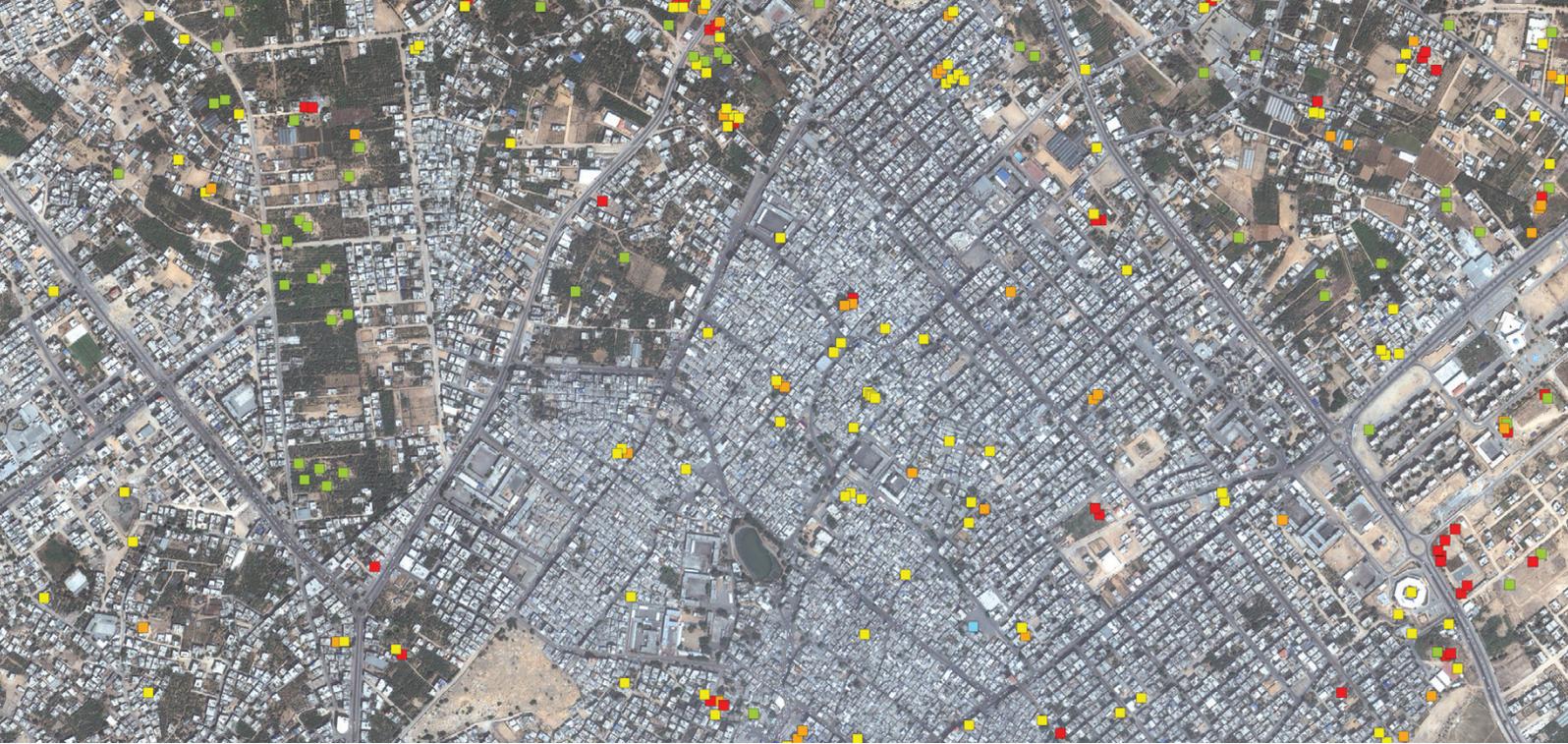
More than one month has passed in Gaza since the open ended cease-fire of 26 August, following a 50 day military operation which killed more than 2,131 Palestinians, of whom 501 children, and 71 Israelis. By the end of August, over 475,000 people in the Gaza Strip had been displaced from their homes, unable to return to their destroyed neighborhoods. As Pierre Krahenbuhl, Commissioner-General of UNRWA highlighted on 14 July 2014, “behind the figures lie multiple individual destinies now torn apart”, a reality no number can translate. What the numbers can do however, is assist in effectively responding to the expectations of the people of Gaza “for an improved future for their children”, at a time where all are now focused on the prospects for sustainable recovery and reconstruction.

In this regard, the present report offers a credible basis for assessing the damages for reconstruction. This builds on UNOSAT’s ability to provide satellite images and analysis from the start of the conflict, thus assisting the United Nations, the Palestinian Government and the donor community to evaluate the situation and plan out further interventions. In this regard, the information provided by UNOSAT’s analyses supported the planning and implementation of the large scale, on the ground, damage assessment. The latter, facilitated by UNDP/PAPP under the leadership of the Palestinian Government is still ongoing, aiming to provide the information needed for future response and reconstruction, structure by structure, over the entire Gaza Strip. On the ground works entail proper documentation and costing of all damages, including for structures that have suffered lighter damages, which satellite imagery cannot capture.

Notwithstanding the fact that all damage may not be visible from above, the report provides numbers which already support an informed analysis of the type of damage, its extent and its geographical location. Beyond the absolute numbers, the analysis also provides the most critical comparison of some of the damages incurred, between the 2008-2009 Cast Lead operation, and the most recent 2014 Protective Edge. At a time where priorities are being set, this information will no doubt enable the Palestinian Government and its international partners to further refine their understanding of the actual needs for the sustainable development of Gaza.

Narjess Saidane

Deputy Special Representative of the Administrator, Programme for Assistance to the Palestinian People, United Nations Development Programme (UNDP)



METHODOLOGY

SATELLITE IMAGERY ANALYSIS

To assess damage in the Gaza Strip UNOSAT reviewed commercial high-resolution satellite imagery and used specialized remote sensing techniques, resulting in in-depth analysis of destruction and damage to residential and industrial buildings, health and educational facilities, roads, and agricultural areas. These analyses, part of UNOSAT Rapid Mapping activities, commenced on 24 July 2014, as combat was ongoing, and concluded on 24 September 2014, resulting in damage assessments at multiple time intervals focusing on various infrastructure types.

The analysis-team assessed all available satellite imagery, acquiring the most relevant scenes available, including select scenes based on the needs of UN partners resulting from the dynamics of combat operations. All imagery used to analyse the conflict was acquired by the Pleiades satellites operated by Airbus Defense and Space which provides imagery with 50cm resolution. This imagery can be slightly downgraded in areas directly proximate to the Armistice Demarcation Line, this had minimal effect on analysis. Occasionally, secondary imagery sources, primarily Bing and Google Earth, were used to help better visualize ground conditions and compensate for intermittent haze, cloud cover, or other interference.

UNOSAT conducted the comprehensive damage assessment using its standard analysis methodology and quality control procedures. All results were provided as both ready-to-use datasets to local actors as well as ready-to-print maps on the area of interest. All products are accessible from the UNOSAT website (www.unitar.org/unosat). The various damage assessment materials produced were also adapted to form the content of this study.

In addition to the 2014 analysis, UNOSAT had analysed the Gaza Strip after the 2008-2009 conflict. Results from that analysis were utilized to create a comparison of destruction and severe damage between 2009 and 2014.

For the full extent of the Gaza Strip, the expert-team conducted the damage assessment with the aim to detect multiple classes of building damage. Notably, damage assessments using satellite imagery are mostly limited to relatively significant and catastrophic levels of structural damage and are not intended to catalogue all damage to buildings. Analysis can only assess what is visible from above, though

IMAGERY USED:

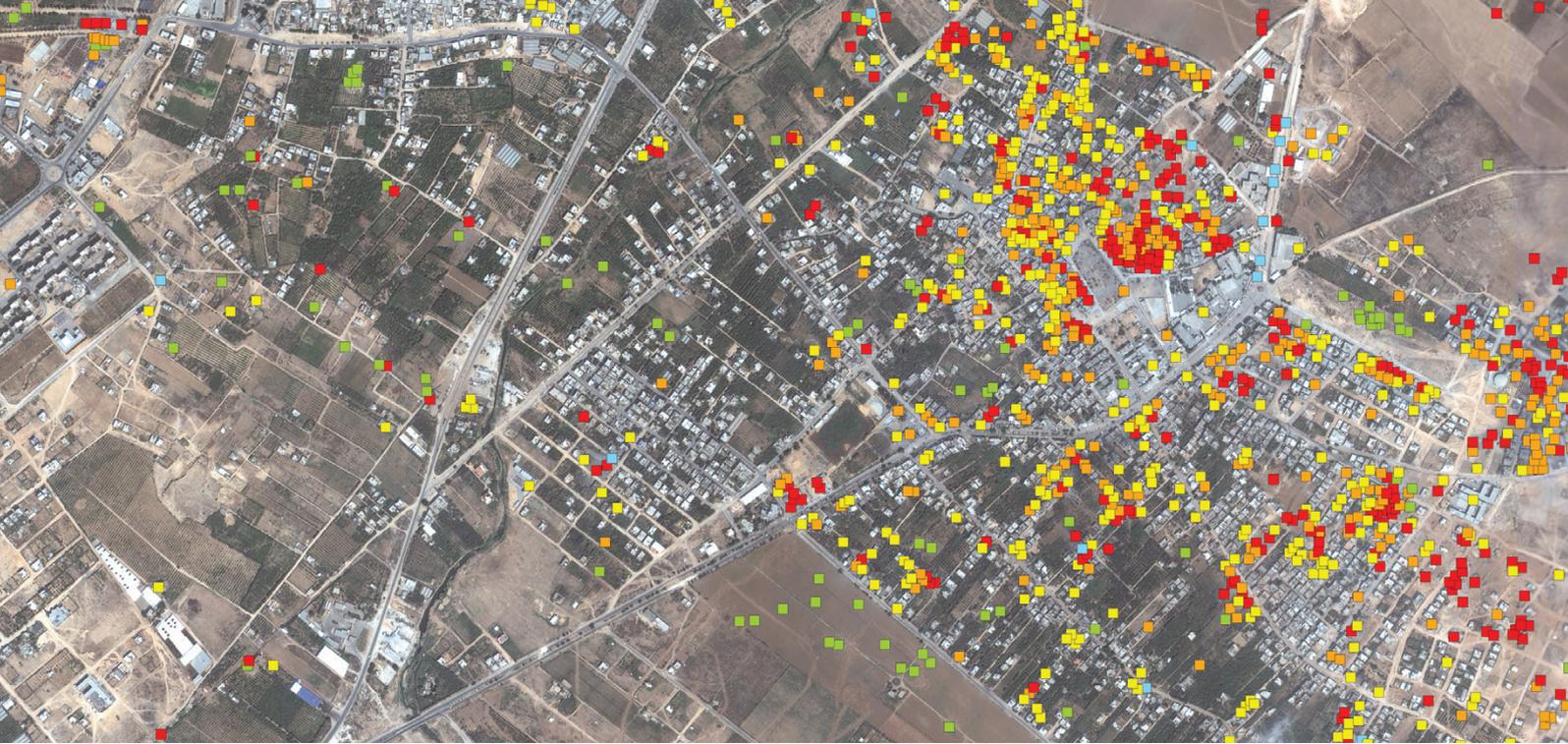
General Damage Assessment:
Three comprehensive damage assessments (CDA) on the Gaza Strip using imagery from:
6 July 2014 (prior to conflict)
25 July and 1 August 2014
14 August 2014
27 and 28 August 2014

Educational Facilities Damage Assessment:
UNOSAT conducted two CDAs on the Gaza Strip using imagery from:
6 July 2014 (prior to conflict)
14 August 2014
27 and 28 August 2014

Health Facilities Damage Assessment: UNOSAT conducted two CDAs on the Gaza Strip using imagery from:
6 July 2014 (prior to conflict)
14 August 2014
27 and 28 August 2014

Agricultural Damage Assessment:
UNOSAT conducted one agricultural damage assessment on the Gaza Strip using imagery from:
6 July 2014 (prior to conflict)
14 August 2014

Image Copyright
All photography by UNITAR-UNOSAT using UN-Asign.
All satellite imagery provided by Airbus Defence and Space © 2014



in some imagery specific conditions, damage to the facade is also apparent. All damage originating from small arms fire, heavy machine gun fire, and direct tank or artillery fire is generally not visible unless it results in some form of structural collapse. Given these limitations and the inherently conservative nature of satellite based damage assessments, the following classes of building damage were identified by UNOSAT:

1. Building Destroyed: all or most of the building structure is collapsed (75-100% of structure destroyed).
2. Building Severely Damaged: a significant part of the building structure is collapsed (30-75% of structure destroyed).
3. Building Moderately Damaged: limited damage observed to the building structure (5-30% of structure damaged).

UNOSAT DAMAGE ASSESSMENT:

The image above shows a small part of the UNOSAT damage assessment using the 28 August 2014 imagery.

- Destroyed
- Severe Damage
- Moderate Damage
- Crater on Road
- Crater in Field

Further, the analysis documented craters in roads and fields, including agricultural fields and “empty” areas, resulting from munitions impacts. Such craters include air dropped munitions which are generally readily apparent, as well as craters resulting from mortar and artillery fire which are often, but not always, visible depending on the type of terrain impacted. For example, an artillery or mortar shell impacting a field with loose soil will leave a crater, but a light mortar round impacting a paved area or harder soil surface often will not leave a crater visible in satellite imagery.

LEVEL OF DAMAGE



Buildings/structures that have suffered **Moderate Damage**



Buildings/structures that have suffered **Severe Damage**



Buildings/structures that have been **Destroyed**



Crater



DAMAGE ASSESSMENT

BUILDINGS, STRUCTURES AND CRATERS

The review of the 367 square kilometers of the Gaza Strip showed a total of 6,761 destroyed, 3,565 severely damaged and 4,938 moderately damaged structures. In addition 7,473 craters in agricultural and non-urbanized areas are also visible in the crisis images. These results are summarised in the table below:

AL ZAFER TOWER, GAZA
 UNOSAT personnel in Gaza can be seen using the free smart phone app, called UN-Assign. It is a tool for taking and sharing geo-tagged photos specifically designed to work over low bandwidth. The photos are automatically mapped, thus helping towards overall situational awareness in complex emergency situations and validation of satellite image analysis. In the background the remains of the Al Zafar Tower. This same building can be seen in the before and after satellite images completely destroyed.

Damage Assessment Summary					
	Destroyed	Severely Damaged	Moderately Damaged	Total Structures Affected	Crater Impact
North Gaza	1,253	761	1,000	3,014	1,702
Gaza	1,963	1,127	1,378	4,468	1,765
Deir Al Balah	809	406	683	1,898	553
Khan Younis	1,749	898	1,379	4,026	1,549
Rafah	987	373	498	1,858	1,904
TOTAL	6,761	3,565	4,938	15,264	7,473

Note that a few areas along the border with Israel were analysed in less detail as imagery was down-sampled. However, this had minimal effect on analysis results as few, if any, structures were located in those areas prior to the start of hostilities.

Concentrations of damage in the Gaza Strip are found overwhelmingly along the Armistice Line with Israel where building demolition was widely apparent in the analysed satellite imagery. Specifically, 74% of all damaged and destroyed buildings, as well as craters, identified by UNOSAT analysts were found within 3 kilometers of the Armistice Line. Analysis indicates that multiple districts within this area, such as Shejaiya and Beit Hanoun, were almost completely razed with the vast majority of structures completely demolished. It should also be noted that the remainder of the Gaza Strip also indicated damage, with more than 5,900 destroyed or damaged buildings and craters located more than 3 kilometers from the Armistice Line. Based on an assessment of crater size and building damage in those interior areas the source of such damage was likely airstrikes, though naval bombardment and impacts from some mortars and artillery are also likely to have caused some of the identified damage.



The observed destruction in the Gaza Strip differed by governorate, with Gaza and Khan Younis experiencing the worst effects with more than 4,000 damaged or destroyed buildings detected. Rafah experienced the least overall destruction with less than 2,000 destroyed or damaged buildings detected, this still being however, a significant impact. Impact craters in fields were relatively evenly distributed among governorates with the exception of Deir Al-Balah which saw about one-third of the bombing and shelling compared to that over the other governorates.

The razed areas such as Shejaiya and Beit Hanoun were likely levelled as a result of focused IDF demolitions efforts. UNOSAT analysis of imagery collected during the conflict, on July 25, show ongoing IDF combat operations as armoured groups 'sequestered' a portion of Shejaiya within a perimeter. Engineering vehicles are visible within the perimeter, and video from media shows the district being destroyed building-by-building at approximately that time. It is likely that a mixture of airstrikes, tank fire, and artillery were used, and perhaps some demolition charges and even bulldozers were then utilized. The destruction visible in these areas represents 100% of buildings and thus would have required relatively significant efforts to achieve.

Artillery and direct fire from tanks and other armoured vehicles were certainly a major factor in building damage in the Gaza Strip. Such munitions likely accounted for the majority of moderately damaged buildings visible in satellite imagery as well as many severely damaged and destroyed buildings. While lighter artillery or

BEIT HANOUN

Beit Hanoun is a neighbourhood inside the North Gaza Governorate, in the northeast edge of the Gaza Strip. Imagery from 28 August 2014 as well as the UN-Asign photography show widespread damage to residential buildings across the Beit Hanoun neighbourhood. A total of 1,003 damage points were identified on imagery inside the neighbourhood boundary including 301 destroyed, 302 severely damaged and 350 moderately damaged buildings.

 Visibly destroyed buildings

 Field of View



ITALIAN TOWER & MALL

Imagery from 28 August 2014 shows severe damage to the Italian Tower and Mall. The tower is a 15-story high-rise apartment building, located on the Al Nasser Street in the northwest of Gaza City. The building's first two floors hosted a shopping mall and the offices of the Housing and Public Works Ministry. The other 13 floors housed four apartments each.

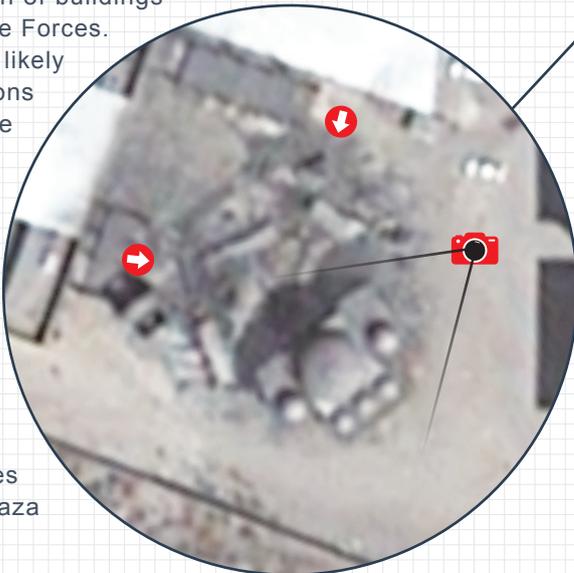
 Visibly damaged buildings



6 Jul 2014

tank fire may not collapse all or part of a building with a single impact, multiple impacts will accumulate sufficient damage until the structural integrity is compromised. Some heavier artillery and tank fire can, much like a bomb, collapse a building with a single impact, especially if the structure in question is not made of reinforced concrete.

Damage characteristics observed by UNOSAT indicate multiple tactics in use during combat operations, including airstrikes, most likely using laser guided bombs of 230 kilograms or larger, artillery and tank fire, as well as focused demolition of buildings in areas under control of the Israeli Defense Forces. Many buildings across the Gaza Strip were likely struck by laser guided air dropped munitions which are capable of collapsing a large building with relatively moderate damage to surrounding areas. The Hamza Mosque, Al Basha Tower, and Italian Tower and Mall, as well as hundreds of other buildings, all were most likely felled by such precision munitions. All are obviously visibly collapsed while surrounding buildings are not, though surrounding buildings certainly experienced some form of collateral damage from the munitions impacting the primary targets. Such damage examples are widespread within the interior of the Gaza Strip.

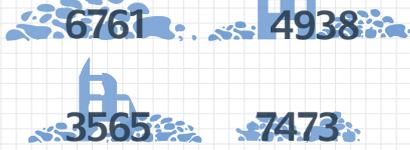


➔ Severely damaged mosque

📷 Field of View

HAMZA MOSQUE, GAZA
Imagery from 28 August 2014 shows that the mosque has been severely damaged

OVERALL DAMAGE

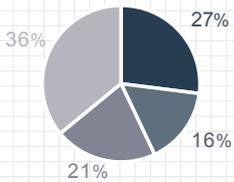


DAMAGE BREAKDOWN

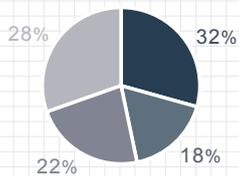
The below charts show the percentage breakdown of damage per governorate.



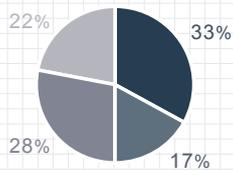
NORTH GAZA



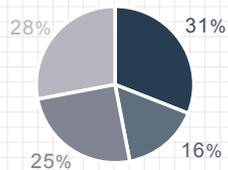
GAZA



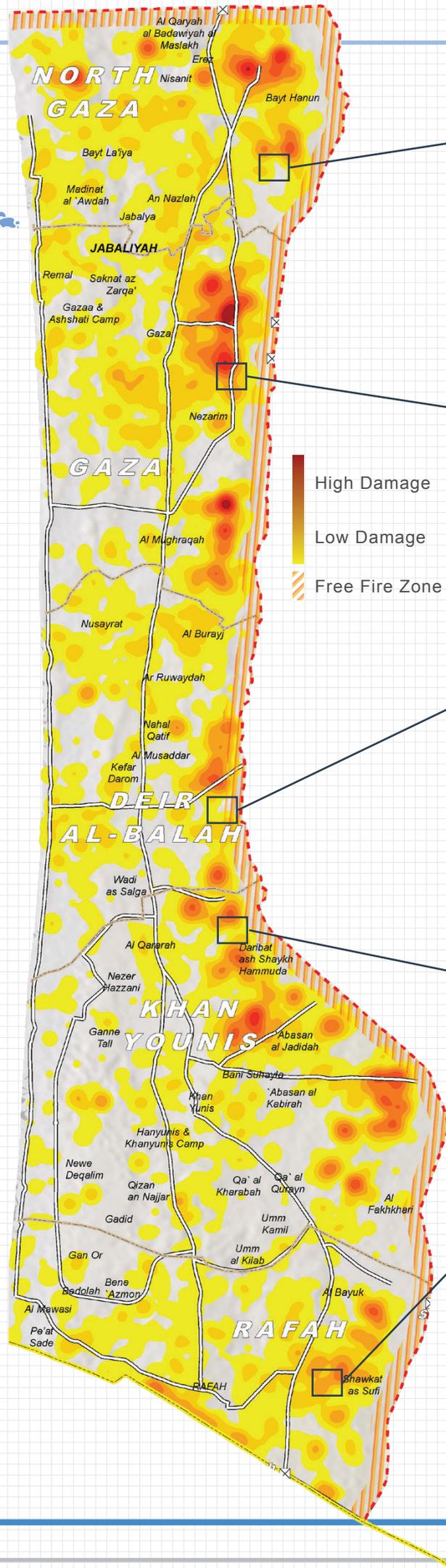
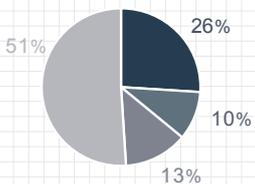
DEIR AL-BALAH



KHAN YOUNIS



RAFAH



Visibly destroyed buildings



Visibly destroyed buildings



Razed agricultural areas



Visibly destroyed buildings



Visible craters



6 Jul 2014

HEALTH FACILITIES

Damage to health facilities in the Gaza Strip was widely reported in the media. UNOSAT assessed damage and destruction to 101 health facilities of various types using reference data from the Palestinian Authority, the United Nations Relief and Works Agency (UNRWA), and Open Street Map to determine exact locations and thus which had been destroyed or damaged. Notably, this list of health facilities compiled by UNOSAT is likely incomplete, but it is the best available at the time of this study. UNOSAT visually reviewed the condition of each identified health facility in the same manner as its wider comprehensive damage assessment for all of the Gaza Strip.

Of the 101 assessed health facilities, the analysis identified a total of 18 damaged or destroyed structures. Damage to the facilities were assessed to be the result of multiple factors, including razing (for the Abssan Health Center in Khan Younis), probable bombing or demolition (in the case of the Wafa Rehabilitation Hospital in Gaza), and shelling (in the case of the Al Karama Hospital in North Gaza).

Notably, the Governorate of Gaza contains 66% of the total damaged health facility structures, with all but one building of the remaining 34% located in North Gaza, and the remaining damaged facility found in Khan Younis. Health facilities in other governorates remained intact as seen in satellite imagery. In addition, while perhaps eight damaged or destroyed facilities lie within a few kilometers of the Armistice Line, an area of concentrated and heavy damage, the remaining eleven are well within the interior of the Gaza Strip



6 Jul 2014



27 Aug 2014

ABSSAN HEALTH CENTRE, KHAN YOUNIS

Imagery from 27 August 2014 shows severe damage to the main health center building. The southern wing of the building is completely destroyed and the remaining northern wing of the building is severely damaged.

 Visibly destroyed buildings



28 Aug 2014

EL Wafa HOSPITAL, GAZA

Imagery from 28 August 2014 shows the El Wafa Hospital in Gaza destroyed, as well as all the surrounding buildings in the periphery, substantiating a WHO report from 21 July 2014 maintaining that El Wafa hospital was evacuated after repeated air strikes and 14 inpatients, all with disabilities, were sent to other hospitals.

101 FACILITIES



According to a recent OCHA report - “Gaza Initial Rapid Assessment”, “Gaza’s health system already suffered from chronic shortages in medicine, medical supplies and equipment” before the recent conflict which has only worsened the current state of the health system. Eighteen percent of all health facilities in the Gaza Strip suffered from some level of detectable damage on imagery, of which: four were found to be completely destroyed (like the El Wafa Hospital on the image above); one severely damaged (as the Abssan Health Facility as seen on the image on the left) and; 13 moderately damaged. The current shortage of health facilities will increase the pressure on the whole health system according to OCHA’s Initial Rapid Assessment report.

Health Facilities Damage Assessment Summary					
	Total Facilities	Total Affected	Destroyed	Severely Damaged	Moderately Damaged
North Gaza	14	5	0	0	5
Gaza	48	12	4	0	8
Deir Al Balah	10	0	0	0	0
Khan Younis	13	1	0	1	0
Rafah	16	0	0	0	0
TOTAL	101	18	4	1	13



6 Jul 2014

EDUCATIONAL FACILITIES

Damage to educational facilities was also widely reported in the media during the July-August 2014 conflict. UNOSAT assessed 467 educational facilities of various types (universities, primary schools, etc.) using reference data from the United Nations Relief Works Agency, the United Nations Office for the Coordinator for Humanitarian Affairs, and Open Street Map. As for health facilities, this list of educational facilities compiled by UNOSAT is likely incomplete, but it is the best available at the time of this study. Each educational facility was visually reviewed by the analysis team in the same manner as its wider comprehensive damage assessment for all of the Gaza Strip.

Of the 467 assessed educational facilities, UNOSAT analysis determined that 31 of these were damaged or destroyed during the conflict. This includes one which was destroyed, ten severely damaged facilities, and 20 moderately damaged facilities. The vast majority of destroyed or damaged schools are found within the Gaza and North Gaza Governorates, which include 74% of the total observed destroyed or damaged education facilities. Khan Younis had seven facilities affected, Deir Al Balah had one, while none were observed in Rafah. Notably, the one destroyed educational facility, the Jamal Abd El-Nasser Secondary School, was in Gaza. In

THE ISLAMIC UNIVERSITY OF GAZA

Imagery from 28 August 2014 shows severe damage to the main administration building of The Islamic University of Gaza, as highlighted on the image above and as seen on the UN-Assign pictures below, supporting reports from OCHA on 3 August 2014 stating that several buildings of the Islamic University in Gaza City sustained severe damage and are in need of repair.

Source: OCHA - Occupied Palestinian Territory: Gaza Emergency Situation report (as of 3 August 2014, 1500hrs)





28 Aug 2014

addition, almost all the severely damaged facilities were also within Gaza.

As with health facilities, while a significant number of the destroyed or damaged educational facilities were within a few kilometres of the Armistice Line the majority of them lie well within the interior of the Gaza Strip. Damages to the facilities were the result of multiple factors, such as razing, direct impact and proximity to impacts of air dropped munitions, and many were likely hit by shelling from mortars, artillery, or tank fire.

Sample images on these pages indicate significant combat activities in proximity to educational facilities. For example, the image showing the Beit Hanoun Secondary School for Boys indicates multiple debris areas around the school. Dirt spread across the road, and in piles in some areas, was likely one or more ad-hoc road blocks which were pushed aside by the IDF. Multiple buildings nearby are clearly destroyed, debris next to the school and some indentation of the school facade indicate damage. However, the Beit Hanoun school buildings are likely repairable and will not require complete reconstruction.

467 FACILITIES



-  Visible moderate damage
-  Field of View

Education Facilities Damage Assessment Summary					
	Total Facilities	Total Affected	Destroyed	Severely Damaged	Moderately Damaged
North Gaza	65	6	0	0	6
Gaza	215	17	1	7	9
Deir Al Balah	52	1	0	1	0
Khan Younis	88	7	0	2	5
Rafah	47	0	0	0	0
TOTAL	467	31	1	10	20



6 Jul 2014



28 Aug 2014



BEIT HANOUN SECONDARY SCHOOL FOR BOYS, NORTH GAZA

Imagery from 28 August 2014 shows possible moderate damage to the north section of the Beit Hanoun Secondary School for Boys building corroborated by UN-Assign ground photos taken 3 September 2014 and substantiated by an UNWRA report from 25 July 2014 stating that the attack on Beit Hanoun School followed three previous incidents in just the past four days of UNRWA shelters being hit by explosive projectiles.

Source: UNRWA - Gaza Situation Report 17, Issue No. 17, 25 July 2014

 Possible debris

 Field of View

The Jamal Abd El-Nasser Secondary School was within an area razed by the IDF and thus likely experienced multiple munitions impacts from artillery, tank fire, and perhaps air strikes, completely destroying one building of the school and severely damaging others. These structures will need reconstruction after debris is cleared. Given the amount of damage in the area it is likely that even the structures remaining on the school grounds sustained significant damage and will need to be rebuilt.



6 Jul 2014



28 Aug 2014

109 SCHOOLS SERVE
AS SHELTERS FOR
337000+ DISPLACED
PERSONS

Source: OCHA "Gaza Initial Rapid Assessment" Report

**JAMAL ABD EL-NASSER
SECONDARY SCHOOL,
GAZA**

Imagery from 28 August 2014 shows severe damage to the Jamal Abd El-Nasser Secondary School. Imagery shows the north wing of the school building completely destroyed and the east wing severely damaged. Additional damage to surrounding buildings and debris are visible as well.

 Visibly destroyed buildings

The Al-Shejae'ia School was almost certainly the target of air strikes as large craters are visible on the school grounds. The munitions impacts spread debris across the school grounds and visibly damaged the northeast building. Shock waves from such explosions would have certainly caused damage to the facades and interiors of surrounding buildings but may or may not have degraded their structural integrity. While some structures certainly require demolition and reconstruction, other structures may be repairable.



6 Jul 2014



28 Aug 2014

**AL-SHEJAE'IA SCHOOL,
GAZA**

Imagery from 28 August 2014 shows extensive severe damage to the male and female schools. Impact craters are clearly visible inside the school grounds and the northeast section of the school is severely damaged.

 Craters and visible severe damage



6 Jul 2014

AGRICULTURAL FACILITIES

Agricultural areas of the Gaza Strip experienced significant destruction during the conflict. Using a variety of remote sensing techniques and manual review, UNOSAT assessed damage occurring as a result of razing, heavy vehicle tracking, bombing, shelling, and related conflict dynamics. The analysis includes damage occurring to both active crop fields and fallow fields, many household gardens, and greenhouses. Due to the special characteristics of the area analysed, razing might have been overestimated in sandy areas. Some ambiguity often exists between unused lands, pasture lands, agricultural fields, and other land cover types.

Analysis indicates that about 1,800 hectares of agricultural fields have likely been razed or heavily damaged by these factors during combat operations. In addition, a total of 657 destroyed, 214 severely damaged and 392 moderately damaged greenhouse structures were identified. These greenhouses are often made of plastic sheeting and were thus easily damaged when ordnance exploded nearby, and were often directly targeted by munitions or razing.

Assessment of craters indicates that primarily air-dropped munitions caused heavy damage to agricultural fields as they result in very large craters which may require a bulldozer to repair, as seen on the satellite image on the right. Many fields were also heavily bombarded with mortars and artillery, thus effectively razing them. However, this analysis does not reflect the thousands of other craters found on agricultural fields which did not result in massive soil displacement. These areas may still hold significant amounts of unexploded ordnance which may present a danger for some time to come. In addition, this analysis does not reflect the many hectares of crops which were desiccated after irrigation systems failed due to power cuts.



CRATER DAMAGE

Above is an example of moderate damage to a greenhouse with large craters in the close vicinity.

GREENHOUSES DESTROYED, NORTH GAZA

A total of 1,263 greenhouses were assessed to be damaged according to the most recent damage assessment using imagery from 27 and 28 August 2014. Imagery shows that 52 percent (or 657) of the total greenhouses found with some level of damage are completely destroyed (as seen on the image above), 17 percent (or 214) we found severely damaged and 31 percent (or 392) were seen with moderate damage (like the greenhouse on the left image).

 Visibly destroyed greenhouse

1800[~] HECTARES OF AGRICULTURAL FIELDS DAMAGED

GREENHOUSES



OCHA estimates that around 40,000 people involved within the agriculture/fishery sector were directly affected by the crisis.

The damage to rural areas and agricultural lands will have direct impact on the lives of those working in this sector. Severe damage to crops and land, and the death of animals all bring loss of income and subsistency.

Source: OCHA "Gaza Initial Rapid Assessment" Report

Agricultural Facilities Damage Assessment Summary

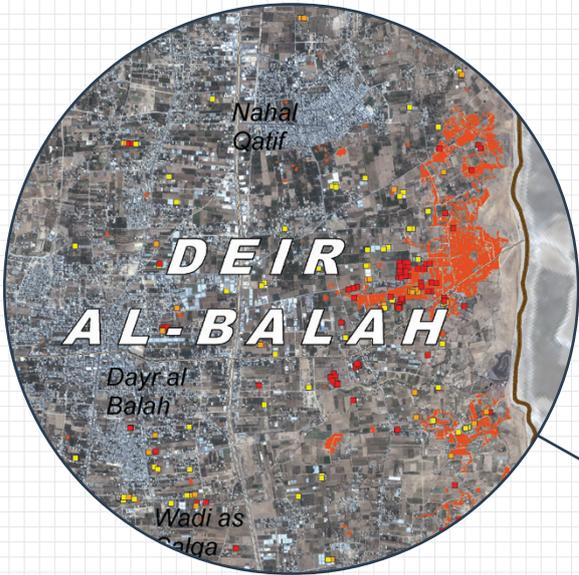
	Total Greenhouses Affected	Destroyed Greenhouses	Severely Damaged Greenhouses	Moderately Damaged Greenhouses	Damaged Areas (Ha)
North Gaza	107	44	29	34	410
Gaza	82	37	22	23	460
Deir Al Balah	254	140	37	77	135
Khan Younis	523	318	72	133	480
Rafah	297	118	54	125	370
TOTAL	1,263	657	214	392	1,855



6 Jul 2014

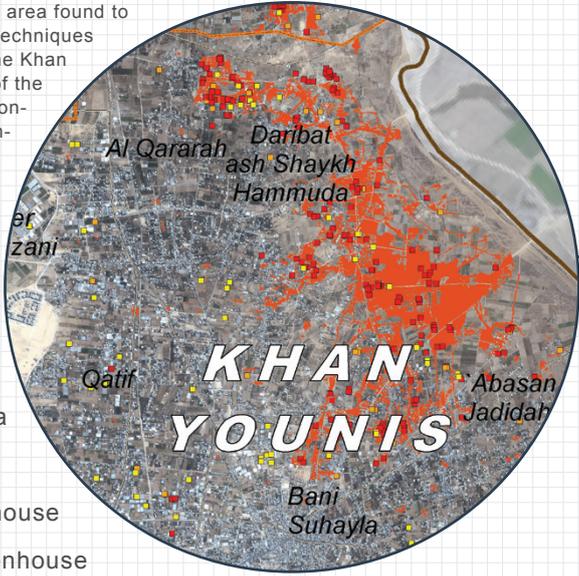
LOSS OF GREENHOUSES

20 percent of the total greenhouses found with visible damage on imagery were seen inside the Deir Al Balah Governorate, of which 140 were found to be destroyed, 37 severely damaged and 77 moderately damaged.



RURAL DEVASTATION

26 percent of the total agricultural area found to be damaged using remote sensing techniques and manual review were inside the Khan Younis Governorate, which is one of the worst affected governorates. Additionally, 41 percent of the total greenhouse seen with visible damage on imagery were found inside the Khan Younis Governorate, of which 318 were found destroyed, 72 severely damaged and 133 moderately damaged.



-  Destroyed Agricultural Area
-  Destroyed Greenhouse
-  Severely Damaged Greenhouse
-  Moderately Damaged Greenhouse



28 Aug 2014

RAZED AREAS

Multiple agricultural areas of the Gaza Strip were heavily damaged during the 2014 conflict and were assessed by UNOSAT using a variety of remote sensing techniques and manual review. Agricultural areas were damaged by razing, as well as by convoys of heavy vehicles driving across them. Razing was a focused effort involving bulldozers or similar equipment and occurred throughout the Gaza Strip and especially in North Gaza and Gaza Governorates. In razed areas the topsoil was visibly scraped away by bulldozer blades in a back-and-forth pattern, resulting in a complete removal of the agricultural fields found at those locations. Heavy vehicle tracks also caused damage to agricultural areas as large numbers of armoured vehicles transited the Gaza Strip, forming new road networks in the process. In some areas they were so common that they constituted a de facto razing of the agricultural fields.



6 Jul 2014



28 Aug 2014

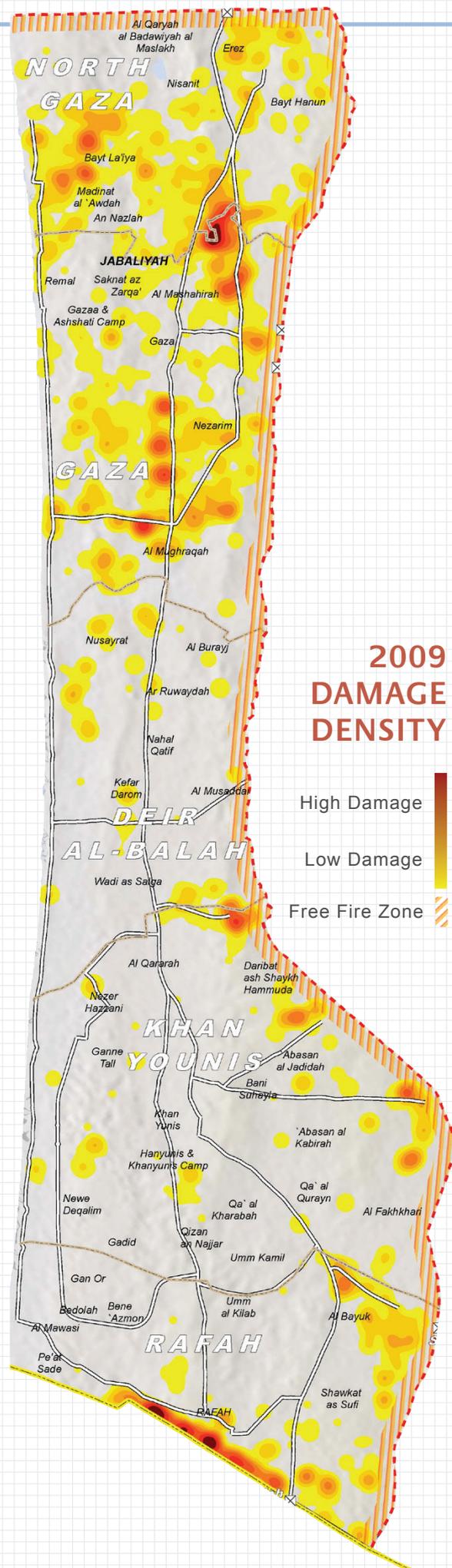
 Visible craters

2009 - 2014 DAMAGE COMPARISON

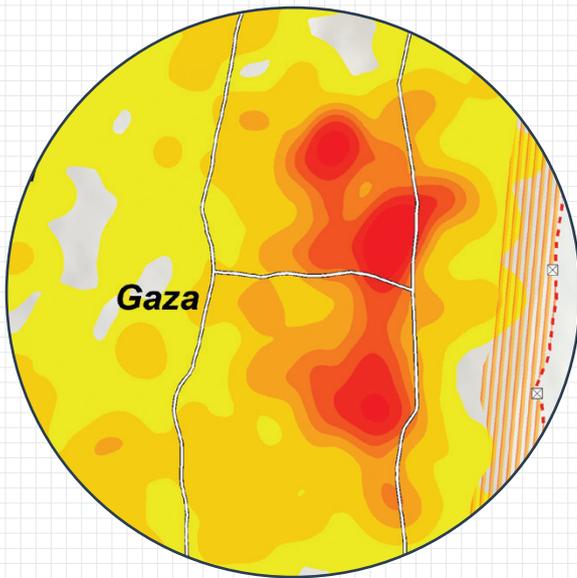
UNOSAT had analysed damage to the Gaza Strip infrastructures in 2009 following Operation Cast Lead (2008-2009). Since similar methodologies were used in both 2009 and 2014, a comparison of the assessment results is possible. However, as the 2008-2009 conflict was assessed with lower resolution (2m) imagery, only the more severe damage was visible, and thus the comparison of the two resulting datasets utilized only the severely damaged and destroyed classes from 2009 and 2014.

Comparison of the two time periods indicates that the 2014 conflict was much more destructive in terms of damage to buildings than the 2008-2009 conflict. The 2008-2009 conflict resulted in a total of 2,852 destroyed or severely damaged buildings detected by UNOSAT, while for 2014 the figure is 10,326. Even accounting for the possible error introduced by the reduced resolution imagery used to analyse the 2008-2009 conflict, this represents a relatively large increase in detected damage. Spatial distribution of the damage is also much more widespread from the 2014 conflict when compared to the 2008-2009 conflict. In 2014, damage occurs in almost every portion of the Gaza Strip.

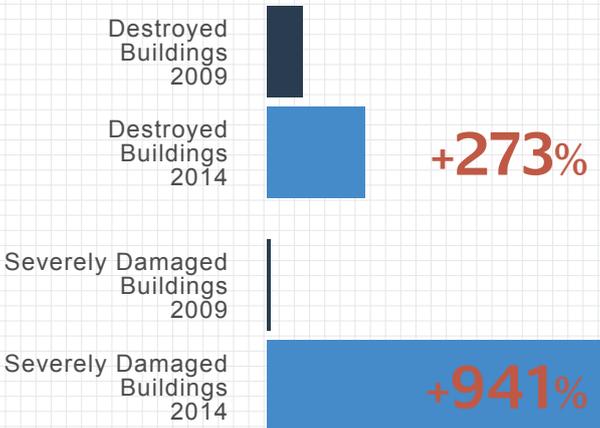
Epicenters of damage do appear to differ significantly from 2008-2009 compared to 2014. For example in 2008-2009 the Rafah border area adjoining Egypt was a prime focus of military activity and thus saw a large amount of destruction. While this area also saw destruction in 2014 it is markedly less intense than 2008-2009. In addition, while Beit Hanoun, Shejaiya, and other areas were heavily targeted in 2014 these same areas were relatively lightly damaged in 2008-2009.



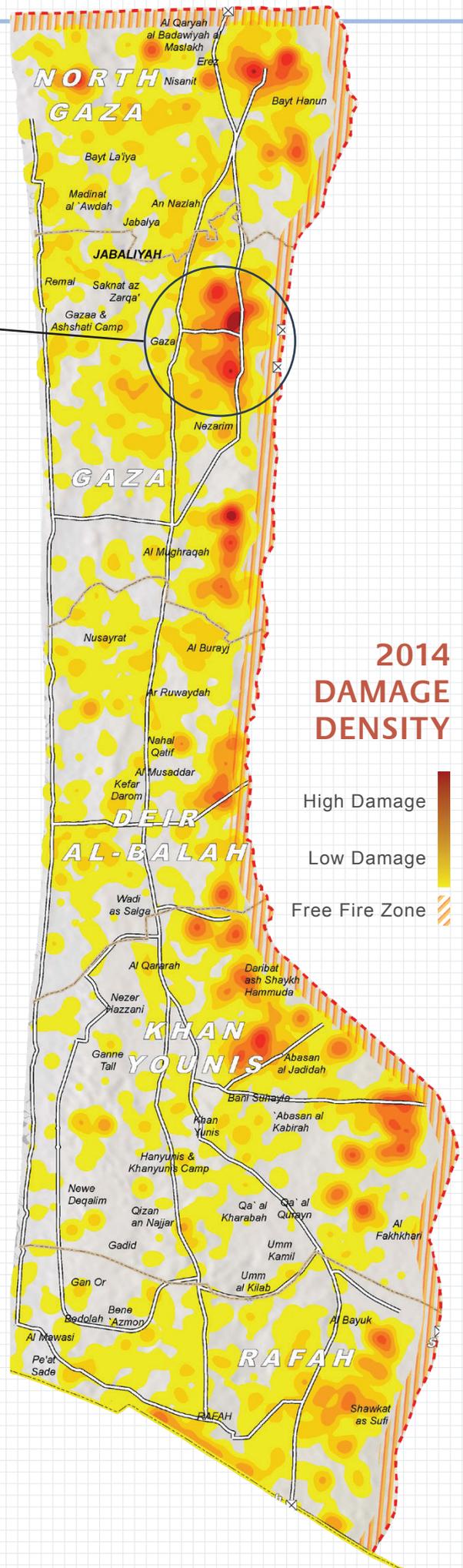
Building Damage Assessment Summary 2009			
	Destroyed	Severe	Total
North Gaza	487	71	558
Gaza	997	175	1,172
Deir Al Balah	33	16	49
Khan Yunis	241	45	286
Rafah	715	72	787
TOTAL	2,473	379	2,852



One of the highest densities of damage was found around the Gaza Governorate close to the border. Of the total 10,326 buildings found with visible damage on imagery in Gaza, 30 percent (or 3,090 damaged buildings in total) were found inside the Gaza Governorate alone with 1,963 destroyed buildings and an additional 1,127 severely damaged buildings.



Building Damage Assessment Summary 2014			
	Destroyed	Severe	Total
North Gaza	1,253	761	2,014
Gaza	1,963	1,127	3,090
Deir Al Balah	809	406	1,215
Khan Younis	1,749	898	2,647
Rafah	987	373	1,360
TOTAL	6,761	3,565	10,326



2014 DAMAGE DENSITY

- High Damage
- Low Damage
- Free Fire Zone

CONCLUSIONS

This study has analysed the detailed damage assessment resulting from UNOSAT Rapid Mapping in support of the humanitarian crisis in the Gaza Strip during July-August 2014. Specifically, this comprehensive analysis revealed 15,264 buildings to be either destroyed, severely damaged or moderately damaged. In addition, a total of 7,473 impact craters were identified.

Out of a total of 101 health facilities assessed, we found 18 destroyed or damaged structures. Similarly, for education facilities, out of 467 locations assessed, 31 were found to be destroyed or damaged.

As for agricultural fields, a total of 1,855ha were identified as razed or heavily damaged, with an additional 1,263 greenhouses either destroyed, severely or moderately damaged.

When comparing our assessment following the 2008-2009 conflict to the recent July-August 2014 conflict, we observed significantly more damage to buildings in 2014 as well as a geographic distribution of this damage more widespread than in 2008-2009.

With the above objective findings, UNOSAT has provided an in-depth analysis of what can be observed from space in terms of damage in the Gaza Strip. While the results overall are conservative estimates, they nevertheless point to an extensive damage level following Operation Protective Edge. All results from this study, as well as data gathered during and immediately after the 2014 conflict, are made available to the international community, including Member States and other actors preparing for the upcoming donor conference in Egypt.

This information can be downloaded from:

www.unitar.org/unosat/gaza

All photography by UNITAR - UNOSAT using UN-Asign.

All satellite imagery provided by Airbus Defence and Space © 2014



Palais des Nations
CH-1211 Geneva 10
Switzerland

Telephone: +41 22 767 4020
Facsimilie: +41 22 917 8047
Email: unosat@unitar.org

www.unitar.org/unosat

The report has been produced
with the kind contribution of
the Government of Denmark.

