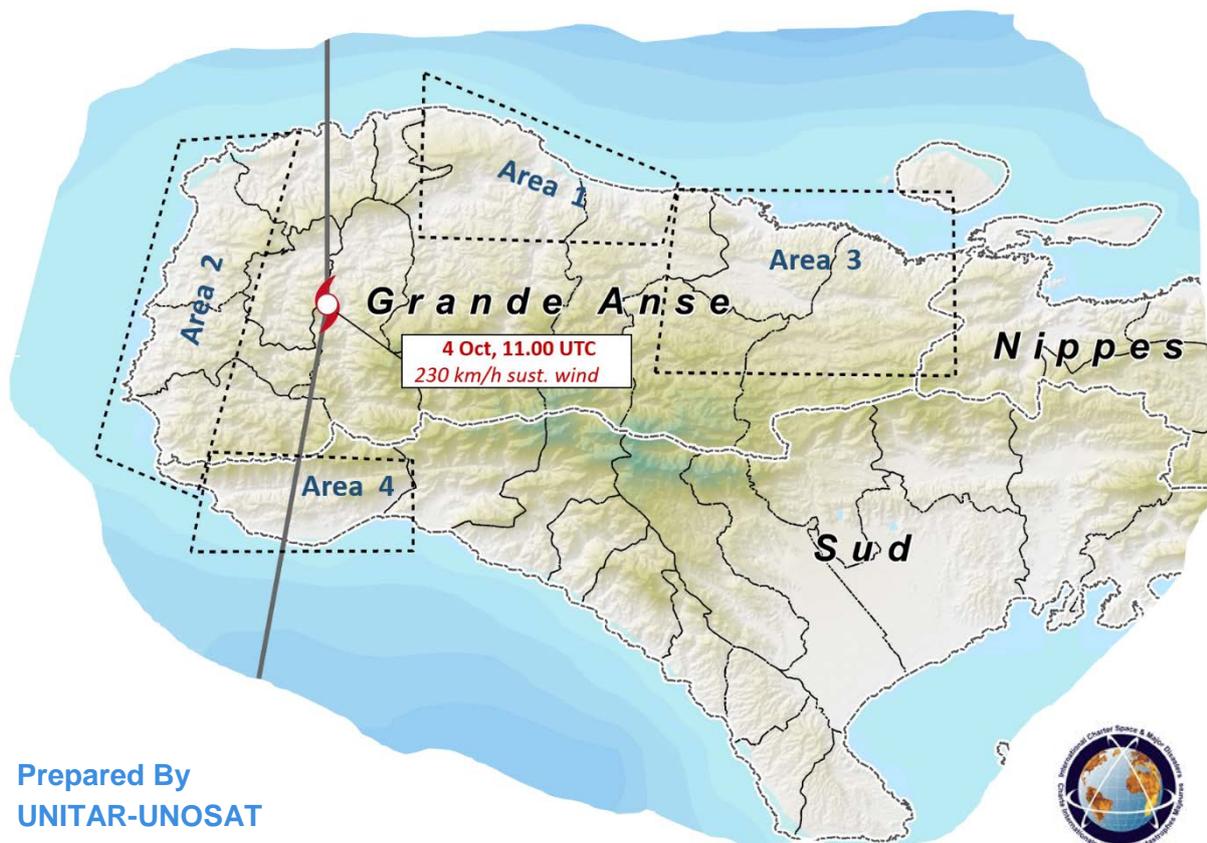


Hurricane Matthew Preliminary Satellite Based Damage Assessment Report: Grand South departments (Grand'Anse, South and Nippes), Haiti

Update 3 (as of 23 Nov. 2016): Areas 1, 2, 3 and 4



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Overview

The first Category 5 Atlantic Hurricane since 2007, Hurricane Matthew, caused widespread destruction along its wake in several countries including Lesser Antilles, Jamaica, Haiti, Cuba, the Bahamas and the United States. Formed near the Windward Islands on 28 September 2016, the hurricane continued over the Caribbean resulting in catastrophic damages including loss of human lives and an estimated overall damage of over 5 Billion USD.

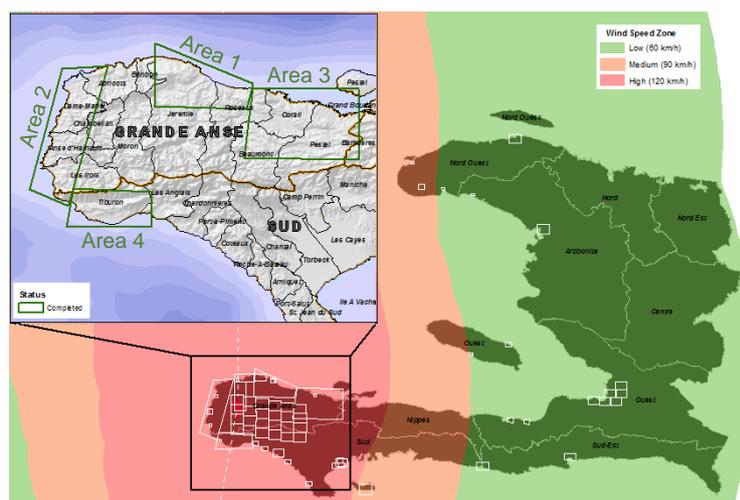
On 4 October 2016, Matthew made a landfall on the Tiburon Peninsula of Haiti. With over 1000 people dead, Haiti has been one of the most impacted countries with an estimated loss of over a billion USD. Preliminary assessment has shown devastating damages to houses, roads, and bridges disrupting aid movement in several departments in the Tiburon Peninsula. It has been reported that 2,128,700 people, or 12% of Haiti's population, have been affected and ~1.5 million people are in need of humanitarian aid ([OCHA Haiti Flash Appeal](#)). This report provides a summary of satellite analysis focused on one of the most affected areas in Haiti, Grand'Anse Département, where over 80% of the population is identified to be in need of humanitarian aid.

UNOSAT's Satellite Support Analysis

[UNITAR-UNOSAT](#) on behalf of UN OCHA activated the [International Charter on Space and Major Disasters](#) on 05 October 2016 to support the planning and coordination of emergency response operations with satellite analysis covering areas affected by Hurricane Matthew. Project Manager (PM) nominated for this Charter Call is Pacific Disaster Center while UNOSAT along with other satellite mapping groups (Copernicus EMS, USGS) are supporting the Charter Call by providing (satellite-derived) value-added analysis & mapping products.

Priority Areas of Interest (AOIs) for satellite imagery acquisition submitted by UNOSAT to the Charter have been requested by UN OCHA and UNCT based on operational requirements to assist most affected communities living in rural and urban areas in Grand South departments (Grand'Anse, Nippes and South). To support the planning and coordination of emergency response operations, UNOSAT has released a [Preliminary Population Exposure Analysis Report](#) based on spatial demographic, cyclone track and wind speed data available, as well as [Preliminary Satellite Based Damage Assessment Reports](#) based on analysis carried out in Jeremie and Roseaux Commune (Area 1), Abricot, Dame-Marie, Anse d'Hainaults and Les Irois Commune (Area 2), Tiburon Commune (Area 4), and surrounding areas.

UNOSAT is also supporting UNOCHA, UNCT, and UNDAC team deployed to hurricane affected areas in Haiti with the overall coordination of satellite analysis. All completed, current and planned analysis areas covered by UNOSAT as well as by other mapping groups can be viewed through [GDACS' Satellite Mapping and Coordination System \(SMCS\)](#).



Overview Map showing areas covered with satellite analysis by all organizations along with Hurricane wind speed; Inset map shows the Areas of Interest (AOIs) completed by UNOSAT.

Note that for AOI 3 covering Corail and Pestel communes, UNOSAT has undertaken flood analysis based on Radarsat-2 image acquired on 08 Oct. 2016: Map produced (Area 3) can be accessed [here](#)

All the maps and products from UNOSAT are available at: <https://www.unitar.org/unosat/maps/HTI> and from Copernicus are available at: <http://emergency.copernicus.eu/mapping/list-of-components/EMSR185>. Combined satellite based damaged assessment is also available through a [LIVE WEB MAP](#).

UNOSAT's satellite derived analysis

This report describes preliminary building damage analysis carried out by UNITAR-UNOSAT covering Area 1 (Jeremie and Roseaux Commune), Area 2 (Abricot, Dame-Marie, Anse d'Hainaults and Les Irois Communes), Area 3 (Corail, Pestel, Beaumont and Roseaux Communes), and Area 4 (Tiburon Commune) for a total area of approximately 1,200 Km².

Building damage analysis, including a rapid assessment of transportation network conditions and locations of spontaneous people gathering sites, was conducted by comparing the post-disaster satellite images (Pleiades acquired on 7/10/2016 for AOI1, Pleiades acquired on 12/10/2016 for AOI2, Pleiades acquired on 09/11/2016 for AOI3 and Worldview-2 acquired on 9/10/2016 & 17/10/2016 for AOI4) with available pre-disaster images (WorldView-1 on 08/12/2014, 01/05/2015, 09/05/2015 and 16/06/2015; Worldview-2 on 17/07/2016, 28/11/2014 and 14/06/2015 and Worldview-3 on 17/10/2015).

UNOSAT's preliminary analysis shows a total of **40,696 buildings/structures** with visible damages and approximately **508** locations with visible road obstacles and/or access constraints. In addition, **1,497 temporary people gathering sites** have been identified within the analysed areas (Area 1, Area 2, Area 3 and Area 4).

Analysis Summary: Area 1, Area 2, Area 3 & Area 4



40,696

Buildings/structures damages



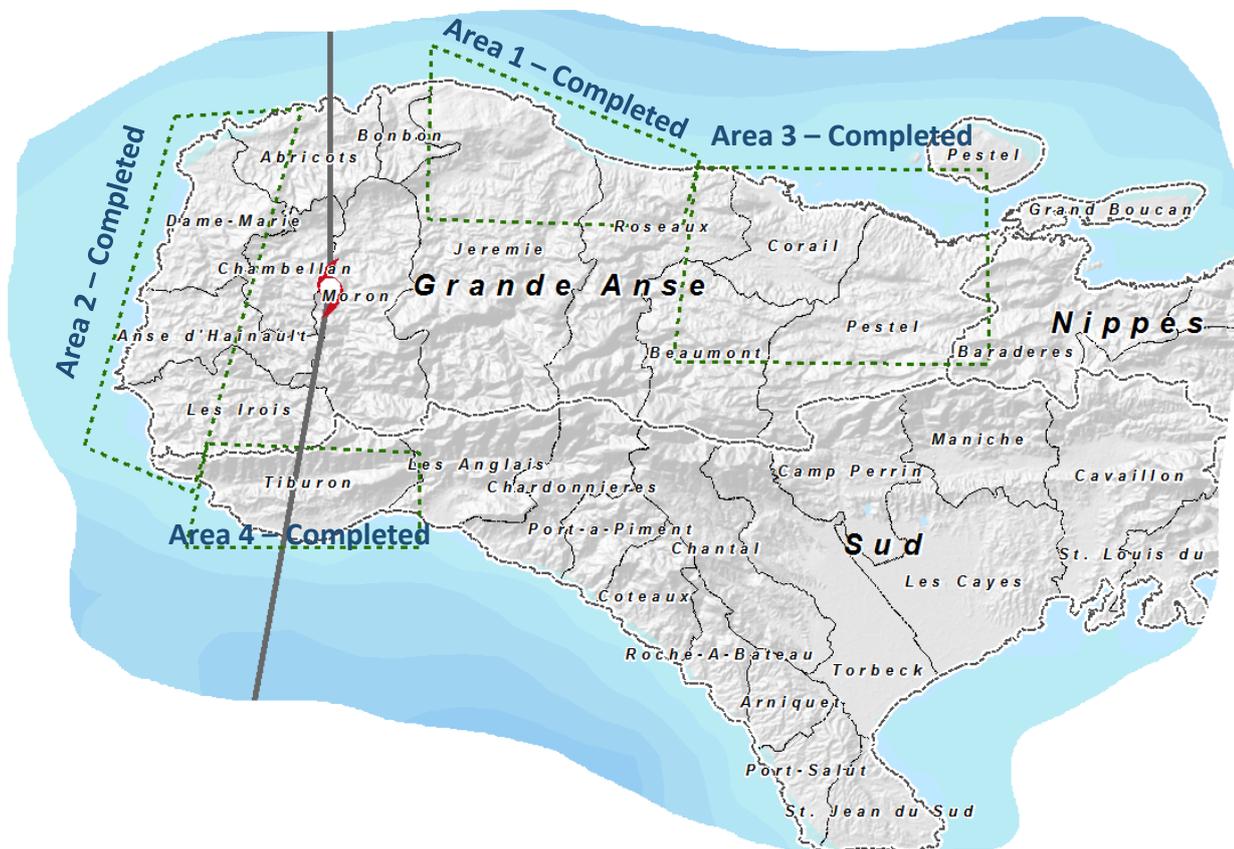
1,497

People gathering sites



508

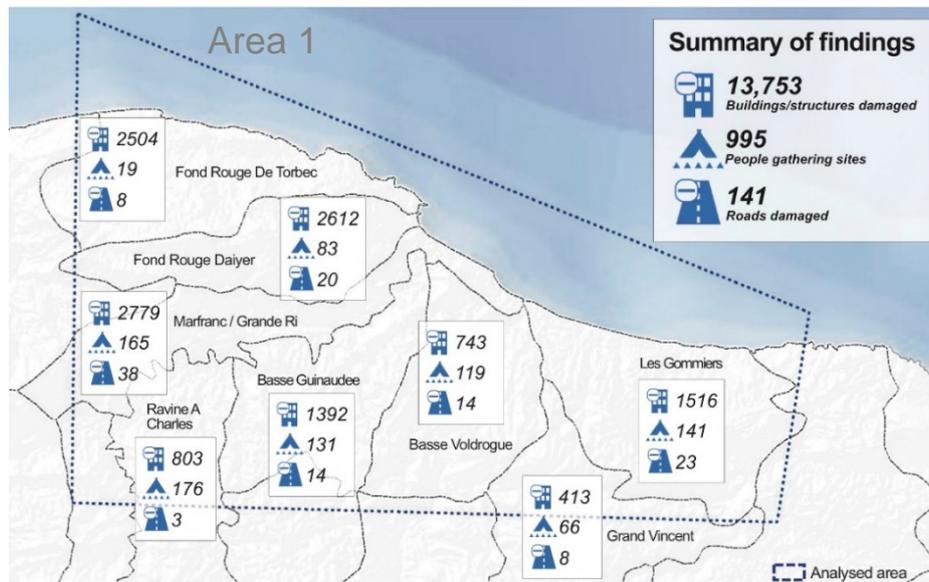
Road obstacles



UNOSAT's satellite derived analysis: Area 1

Satellite analysis for Area 1 covering approximately 260 Km² in Jérémie and Roseaux Communes was conducted by comparing the post-disaster satellite images (Pleiades acquired on 7/10/2016) with available pre-disaster images (WorldView-1 on 01/05/2015 and 08/12/2014).

UNOSAT's preliminary analysis shows a total of **13,753 buildings/structures** with visible damages and approximately **141 locations with visible road obstacles and/or access constraints**. In addition, **995 temporary people gathering sites** have been identified within the analysed Area 1.



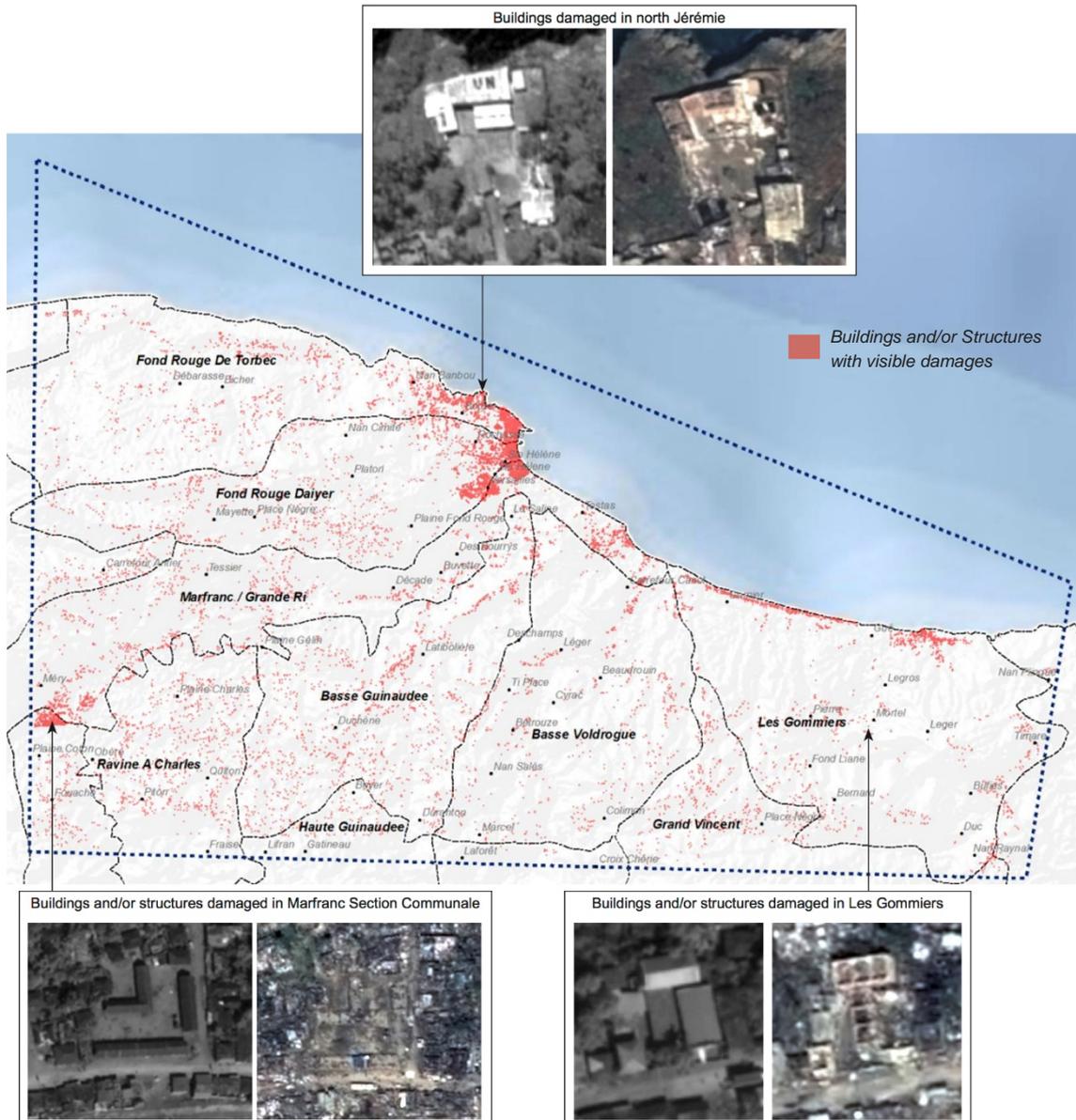
Département	Commune	Sections Communales	Damaged Buildings	Road Obstacles	People Gathering Sites
Grand'Anse	Bonbon	<i>Desormeau</i>	190	5	34
	Jérémie	<i>Basse Guinaudee</i>	1,392	14	131
		<i>Basse Voldrogue</i>	743	14	119
		<i>Fond Rouge Daiyer</i>	2,612	20	83
		<i>Fond Rouge De Torbec</i>	2,504	8	19
		<i>Haute Guinaudee</i>	98	4	7
		<i>Haute Voldrogue</i>	15	2	-
		<i>Iles Blanches</i>	617	2	47
		<i>Marfranc / Grande Ri</i>	2,779	38	165
	<i>Ravine A Charles</i>	803	3	176	
	Roseaux	<i>Carrefour Charles/Ja</i>	71	-	7
		<i>Grand Vincent</i>	413	8	66
		<i>Les Gommiers</i>	1,516	23	141
TOTAL			13,753	141	995

Table showing analysis summary by different administrative levels (Départements, Communes, Sections Communales). There are a total of 13,753 affected buildings, 141 road obstacles and 995 people gathering sites.

Building/Structure damage assessment: Area 1

Preliminary building/structure damage assessment was conducted through visual interpretation by UNITAR-UNOSAT utilizing before and after very high resolution satellite imageries. The post-disaster satellite images were acquired from Pleiades on 7/10/2016 with available pre-disaster images from WorldView-1 on 01/05/2015 and 08/12/2014).

A total of 13,753 buildings were identified to have suffered prominent visible damages within the analyzed areas. Marfranc (section communale) has been identified to have the highest number of affected buildings with over 2,700 detected damaged buildings.



Map showing the buildings/structures identified (red dots) with visible damage using pre- and post- satellite imageries

Excel table with building damage statistics summarized by Administrative Levels for Area 1 can be downloaded [here](#)

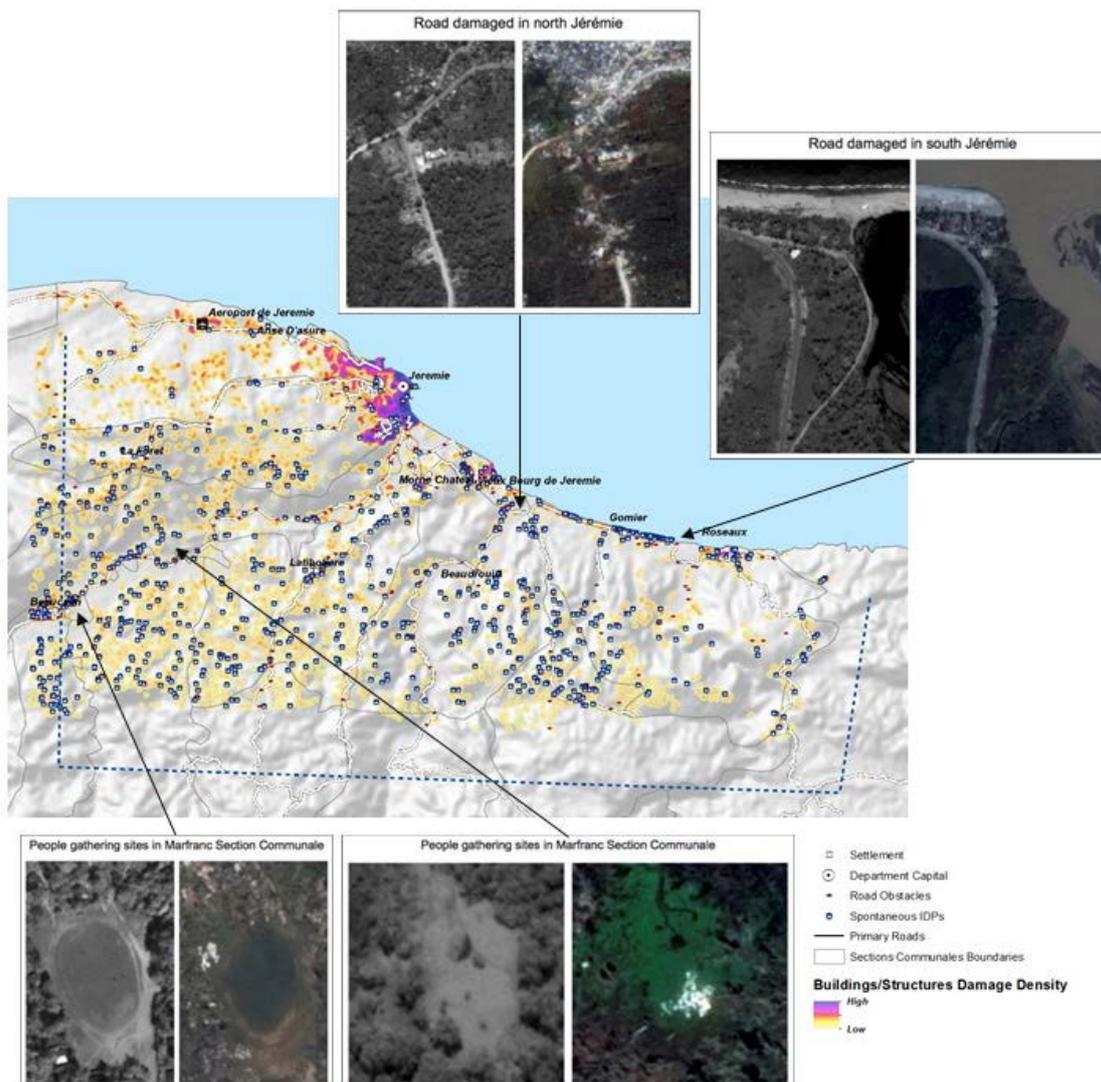
Note that damage statistics are derived from UNOSAT&Copernicus damage points and OSM building footprints (as of 17 Oct. 2016).

Rapid assessment of transport networks and people gathering sites: Area 1

Preliminary damage assessment of transport network with main focus on primary roads and bridges was conducted throughout Area 1. The Conditions of roads are crucial in terms of access to humanitarian aid and rescue teams.

Within Area 1, a total of 141 locations with visible road obstacles and/or access constraints have been identified with most affected Section Communale being Ravine A Charles in Jérémie Commune.

According to a recent UN OCHA report (12/10/2016), at least 175,500 have been evacuated or displaced and housed in 224 temporary shelters across Haiti. Within the analyzed extent in the Communes of Jérémie, Bonbon and Roseaux, UNOSAT has identified a total of 995 temporary people gathering sites.

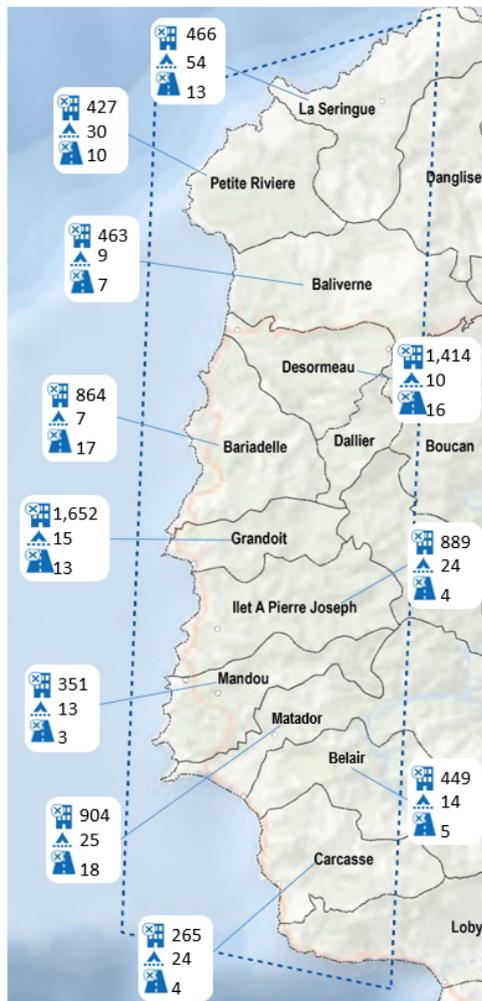


Map depicts the location of road obstacles and people gathering sites overlaid on building damage density within Area 1. Note the increase in the number of temporary people gathering sites where the level of damage is high.

UNOSAT's satellite derived analysis: Area 2

Satellite analysis for Area 2 covering approximately 360 Km² in Abricots, Dame-Marie, Anse d'Hainault and Les Irois communes was conducted by comparing the post-disaster satellite images (Pleiades acquired on 12/10/2016) with available pre-disaster images (WorldView-1 on 09/05/2015 and WorldView-2 on 17/07/2016).

UNOSAT's preliminary analysis shows a total of **9,173 buildings/structures** with visible damages and approximately **255 locations with visible road obstacles and/or access constraints**. In addition, **123 temporary people gathering sites** have been identified within the analysed Area 2.



Analysis Summary: Area 2

-  **9,173**
Buildings/structures damages
-  **255**
People gathering sites
-  **123**
Road obstacles

Département	Commune	Section Communale	Damaged Buildings	Road Obstacles	People Gathering Sites
Grand' Anse	Abricots	Dangleise	51	-	2
		La Seringue	566	13	54
	Anse d'Hainault	Boudon	366	3	12
		Grandoit	1652	13	15
		Ilet A Pierre Joseph	889	4	24
	Chambellan	Mandou	351	3	13
		Boucan	173	-	3
	Dame-Marie	Baliverne	563	7	9
		Bariadelle	864	17	7
		Dallier	151	2	3
		Desormeau	1414	16	10
		Petite Riviere	427	10	30
	Les Irois	Belair	449	5	14
		Carcasse	265	4	24
		Matador / Jorgue	904	18	25
	Sud	Tiburon	Loby	88	8
TOTAL			9,173	123	255

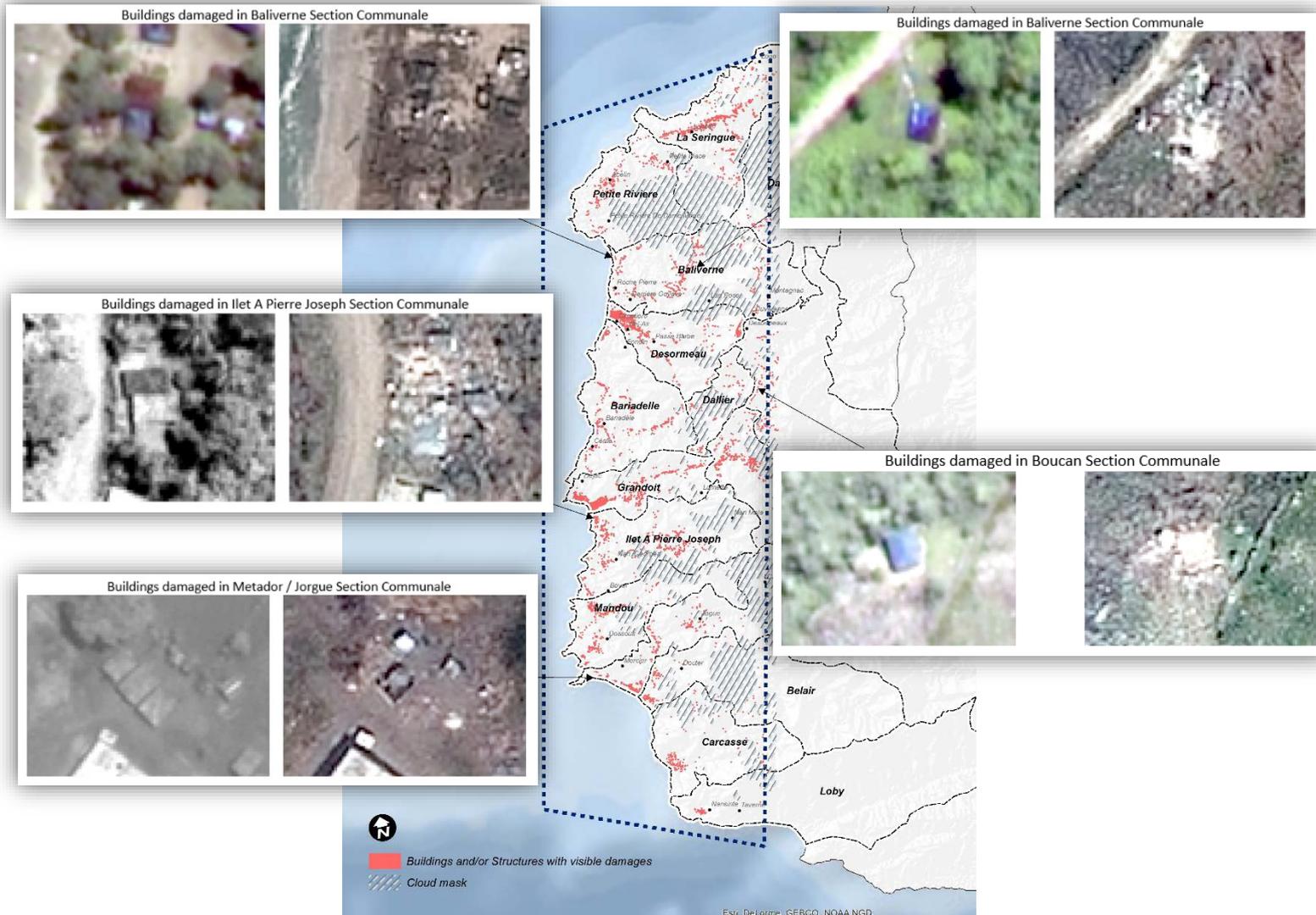
Table showing analysis summary by different administrative levels (Départements, Communes, Sections Communales)
There are a total of 9,173 affected buildings, 123 road obstacles and 255 people gathering sites.

Building/Structure Damage Assessment: Area 2

Preliminary building/structure damage assessment was conducted through visual interpretation by UNITAR-UNOSAT utilizing before and after very high resolution satellite imagery. The post-disaster satellite images were acquired from Pleiades satellite on 12/10/2016 with available pre-disaster images from WorldView-1 on 09/05/2015 and WorldView-2 on 17/07/2016.

A total of 9,173 buildings were identified to have suffered prominent visible damages within Area 2.

Grandoit (section communale) has been identified to have the highest number of affected buildings with over 1,650 detected damaged buildings.



Map showing the buildings/structures identified (red dots) with visible damage using pre- and post- satellite imagery. Note that due to cloud cover in post-disaster satellite imagery (~20%) not all buildings/structures in Area 2 have been assessed.

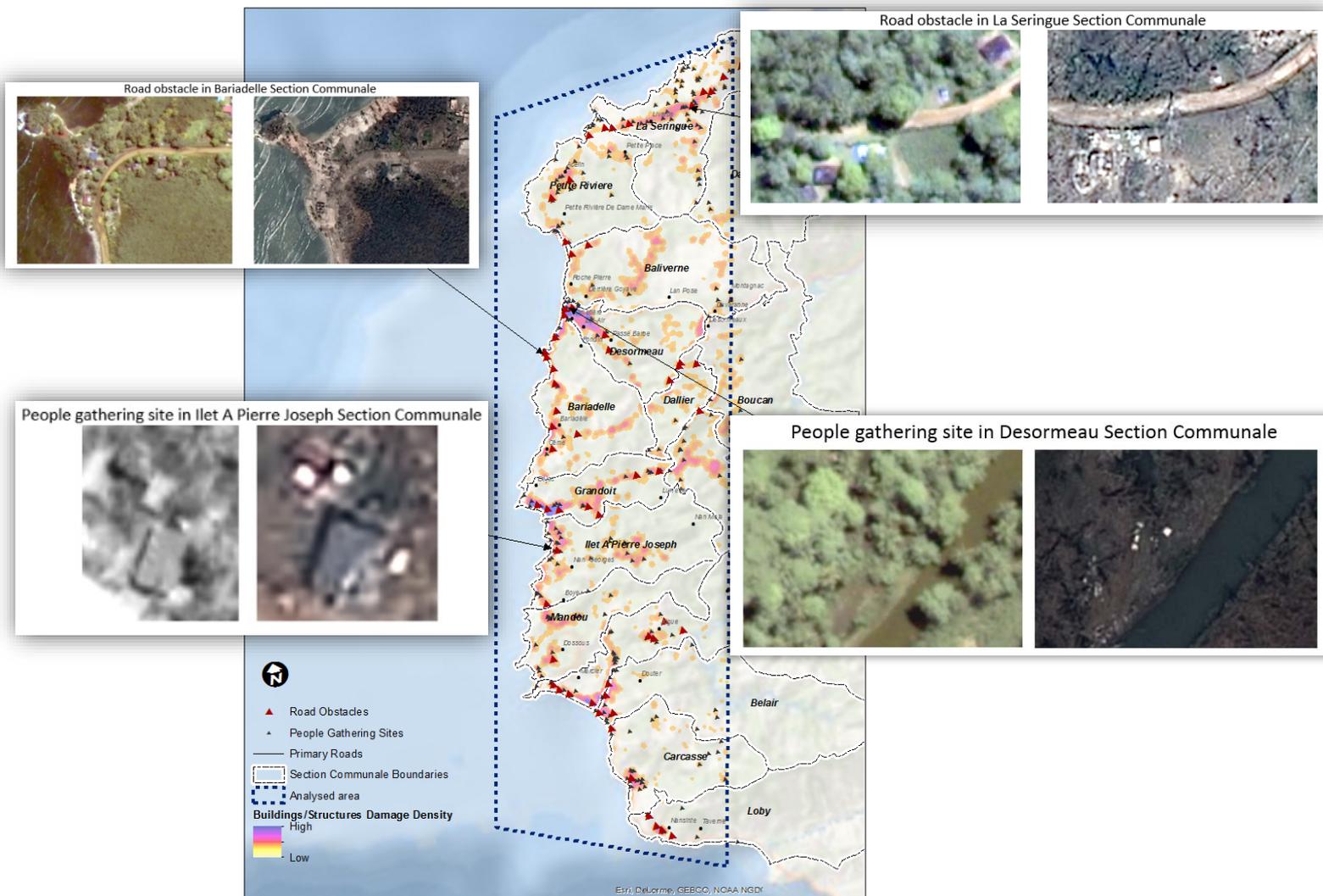
Excel table with building damage statistics summarized by Administrative Levels for Area 2 can be downloaded [here](#)

Note that damage statistics are derived from UNOSAT&Copernicus damage points and OSM building footprints (as of 17 Oct. 2016).

Rapid assessment of transport networks and people gathering Sites: Area 2

Preliminary damage assessment of transport network with main focus on primary roads and bridges was conducted throughout Area 2.

Within the Area 2, a total of 123 locations with visible road obstacles and/or access constraints have been identified. Most affected Section Communale is Matador / Jorgue in Les Irois Commune. Also, within the analysed Area 2, UNITAR-UNOSAT has identified a total of 255 temporary people gathering sites.

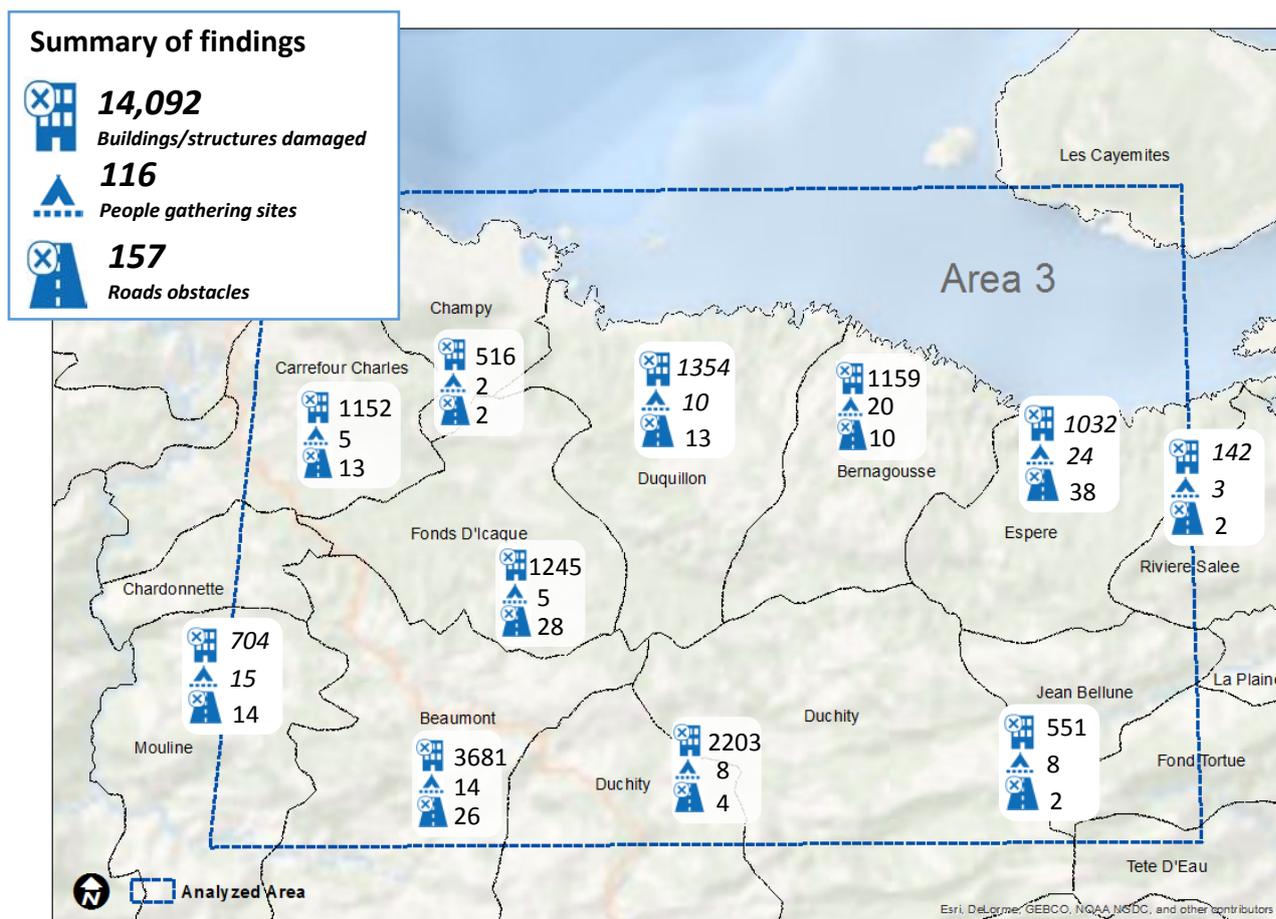


Map depicts the location of road obstacles and people gathering sites overlaid on building damage density within the analysed area. Note the increase in the number of temporary people gathering sites where the level of damage is high.

UNOSAT's satellite derived analysis: Area 3

Satellite analysis for Area 3 covering approximately 400 km² in Corail, Pestel, Beaumont and Roseaux Communes, located in the eastern part of Grand'Anse Department, was conducted by comparing the post-disaster satellite images (Pleiades acquired on 09/11/2016 and WorldView-2 acquired on 14/10/2016) with available pre-disaster images (WorldView-2 acquired on 28/11/2014 and 14/06/2015).

UNOSAT's preliminary analysis shows a total of **14,092 buildings/structures** with visible damages and about **157 locations with visible road obstacles and/or access constraints**. In addition, **116 temporary people gathering sites** have been identified within the analysed Area 3.



Département	Commune	Section communale	Damaged Buildings	Road Obstacles	People Gathering Sites
Grand'Anse	Beaumont	Beaumont	3,681	26	14
		Chardonnette	175	-	2
		Mouline	704	14	15
	Corail	Champy (Nan Campeche)	516	2	2
		Duquillon	1,354	13	10
		Fonds D'Icaque	1,245	28	5
	Pestel	Bernagousse	1,159	10	20
		Duchity	2,203	4	8
		Espere	1,032	38	24
		Jean Bellune	551	2	8
	Roseaux	Carrefour Charles/Ja	1,152	13	5
		Les Gommiers	44	3	-
	NIPPES	Baraderes	Fond Tortue	123	2
La Plaine			1	-	-
Riviere Salee			142	2	3
Tete D'Eau			10	-	-
TOTAL			14,092	157	116

table shows the analysis summary by administrative levels (Départements, Communes and Sections Communales).
There are a total of 14,092 affected buildings, 157 road obstacles and 116 people gathering sites.

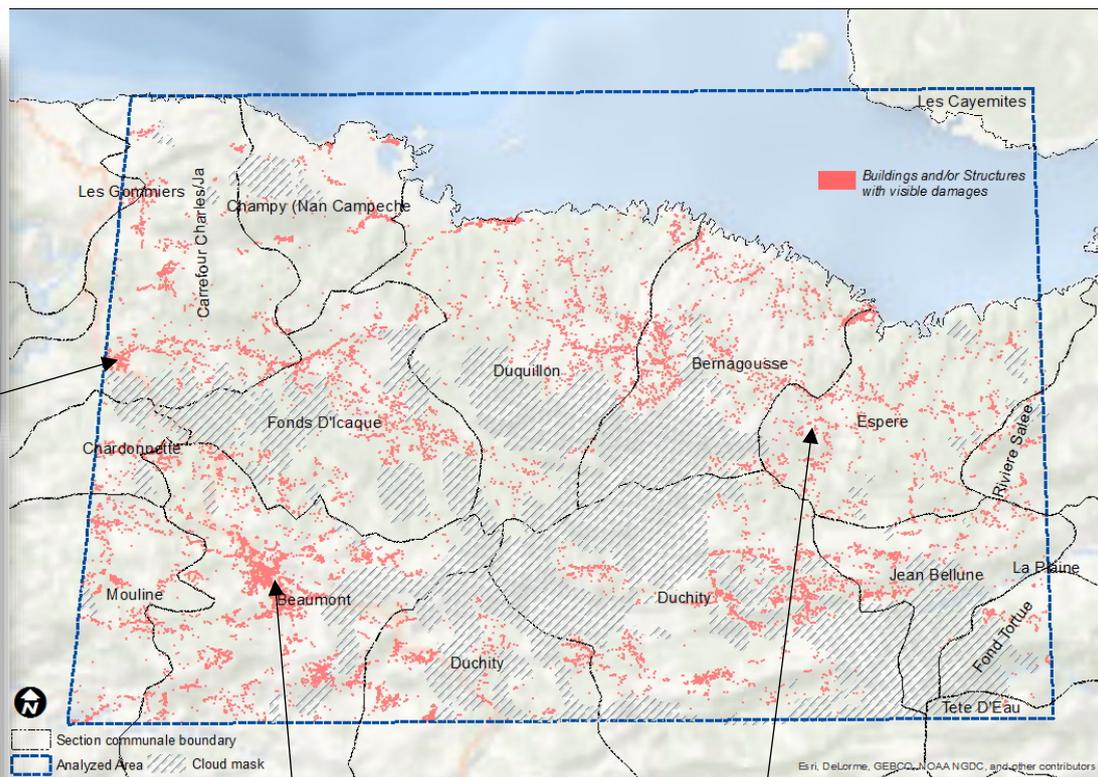
Building/Structure damage assessment: Area 3

Preliminary building/structure damage assessment was conducted through visual interpretation by UNITAR-UNOSAT utilizing before and after very high resolution satellite imageries. The post-disaster satellite images were acquired from Pleiades acquired on 09/11/2016 and Worldview-2 acquired on 14/10/2016 with available pre-disaster images from Worldview-2 acquired on 28/11/2014 and 14/06/2015.

A total of 14,092 buildings were identified to have suffered prominent visible damages within area 3.

Beaumont (section communale) has been identified to have the highest number of affected buildings with over 3680 detected damaged buildings.

Buildings and/or structures damaged in Carrefour Charles Section Communale



Buildings and/or structures damaged in Beaumont Section Communale

Buildings and/or structures damaged in Espepe Section Communale



The map shows the buildings/structures identified (red dots) with visible damage using pre-and post- satellite imageries
 Note that due to cloud cover in post-disaster satellite imagery (~30%) not all buildings/structures in Area 3 have been assessed

Excel table with building damage statistics summarized by Administrative Levels for Area3 can be downloaded [here](#)
 Note that damage statistics are derived from UNOSAT damage points and OSM building footprints (as of 17 Oct. 2016).

Rapid assessment of transport networks and people gathering sites: Area 3

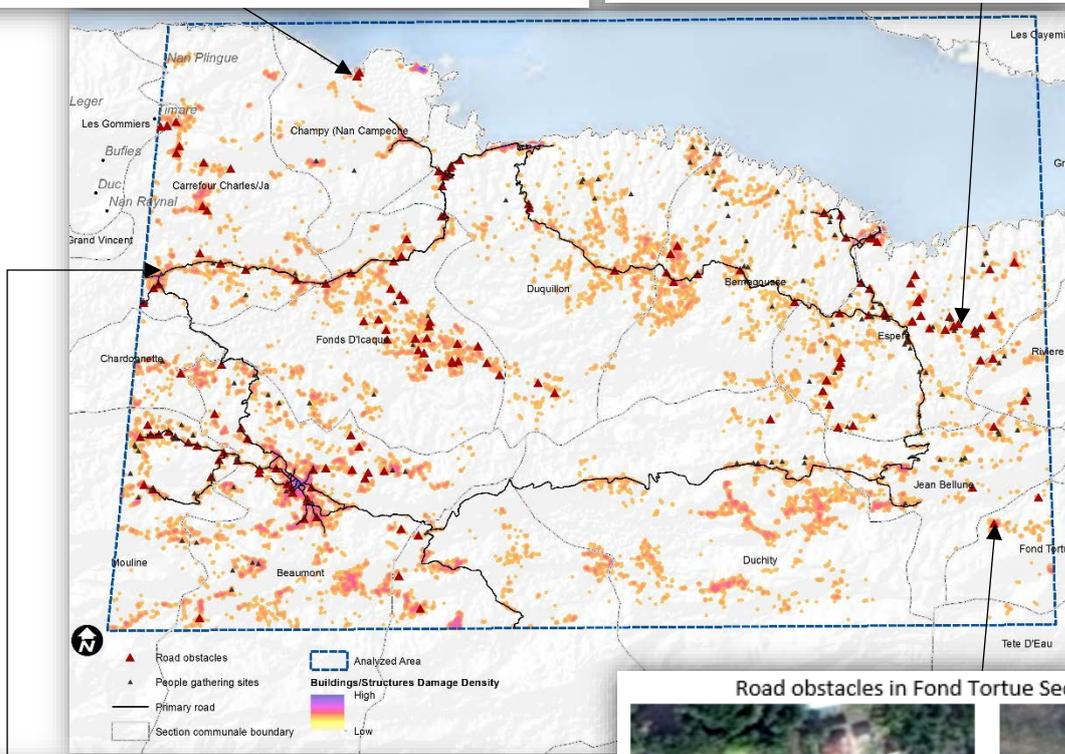
Preliminary damage assessment of the transport network with main focus on primary roads and bridges was conducted throughout Area 3.

Within this area, a total of 157 locations with visible road obstacles and/or access constraints have been identified. Most affected Sections Communales are Espere in Pestel Commune with 38 locations and Fonds d'Icaque in Corail Commune with 28 locations. Also, within the analysed Area 3, UNITAR-UNOSAT has identified a total of 116 temporary people gathering sites. Note that the total number of people gathering sites in this area 3 might be underestimated due to the late acquisition (09/11/2016) of the post-disaster Pleiades image.

Road obstacle in Champy Section Communale



People gathering site in Espere Section Communale



Road obstacles in Fond Tortue Section Communale



People gathering site in Carrefour Charles/Ja Section Communale

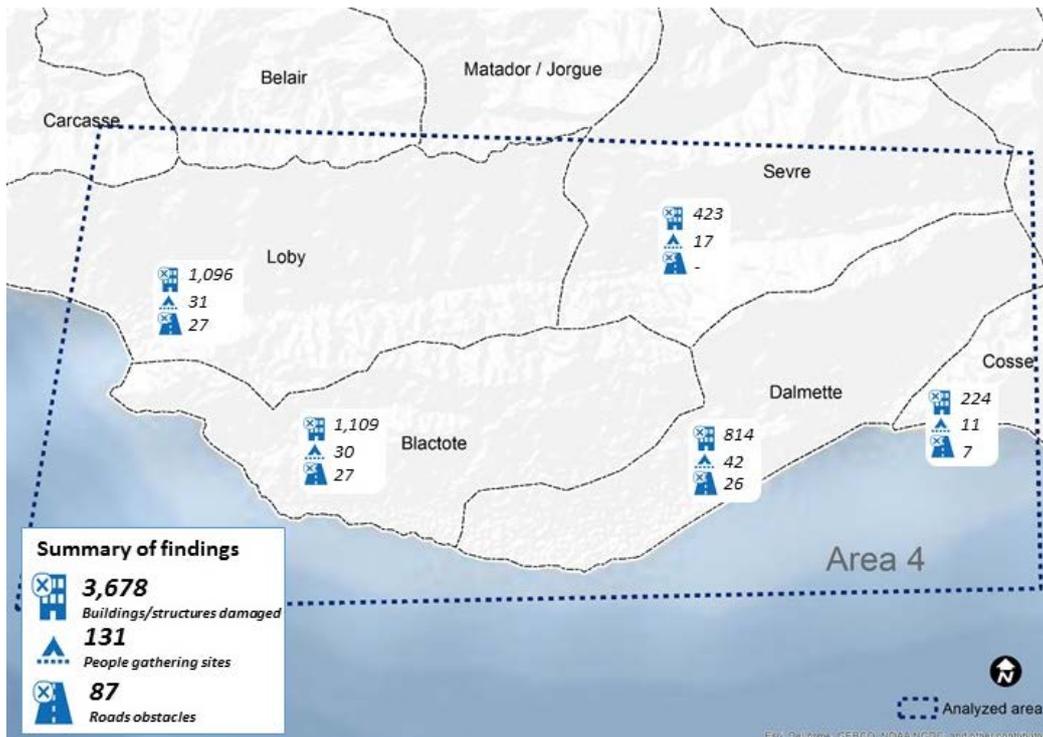


The map depicts the location of road obstacles and people gathering sites overlaid on building damage density within Area 3.

UNOSAT's satellite derived analysis: Area 4

Satellite analysis for Area 4 covering approximately 180 km² in Tiburon Commune, located in the western part of Sud Department, was conducted by comparing the post-disaster satellite images (WorldView-2 acquired on 09/10/2016 and 17/10/2016) with available pre-disaster images (WorldView-1 on 16/06/2015, WorldView-3 on 17/10/2015 and WorldView-2 on 17/07/2016).

UNOSAT's preliminary analysis shows a total of **3,678 buildings/structures** with visible damages and approximately **87 locations with visible road obstacles and/or access constraints**. In addition, **131 temporary people gathering sites** have been identified within the analysed Area 4.



Département	Commune	Sections Communales	Damaged Buildings	Road Obstacles	People Gathering Sites
Sud	Tiburon	Blactote	1,109	27	30
		Loby	1,096	27	31
		Dalmette	814	26	42
		Sevre	423	-	17
	Les Anglais	Cosse	224	7	11
Grand'Anse	Les Irois	Carcasse	11	-	-
		Belair	1	-	-
TOTAL			3,678	87	131

The table shows the analysis summary by administrative levels (Départements, Communes and Sections Communales). There are a total of 3,678 affected buildings, 87 road obstacles and 131 people gathering sites.

Building/Structure damage assessment: Area 4

Preliminary building/structure damage assessment was conducted through visual interpretation by UNITAR-UNOSAT utilizing before and after very high resolution satellite imageries. The post-disaster satellite images were acquired from WorldView-2 on 09/10/2016 and 17/10/2016 with available pre-disaster images from WorldView-1 on 16/06/2015, WorldView-3 on 17/10/2015 and WorldView-2 on 17/07/2016.

A total of 3,678 buildings were identified to have suffered prominent visible damages within area 4.

Blactote (section communale) has been identified to have the highest number of affected buildings with over 1,100 detected damaged buildings.



The map shows the buildings/structures identified (red dots) with visible damage using pre-and post- satellite imageries

Note that due to cloud cover in post-disaster satellite imagery (~11%) not all buildings/structures in Area 4 have been assessed

Excel table with building damage statistics summarized by Administrative Levels for Area4 can be downloaded [here](#)

Note that damage statistics are derived from UNOSAT damage points and OSM building footprints (as of 17 Oct. 2016).

Rapid assessment of transport networks and people gathering sites: Area 4

Preliminary damage assessment of the transport network with main focus on primary roads and bridges was conducted throughout Area 4.

Within this area, a total of 87 locations with visible road obstacles and/or access constraints have been identified. Most affected Sections Communales are Blactote and Loby in Tiburon Commune with 27 locations each. Also, within the analysed Area 4, UNITAR-UNOSAT has identified a total of 131 temporary people gathering sites.



The map depicts the location of road obstacles and people gathering sites overlaid on building damage density within Area 4. Note the increase in the number of temporary people gathering sites where the level of damage is high.

All the maps and products from UNOSAT are available at: <https://www.unitar.org/unosat/maps/HTI>
Combined satellite damaged assessment done by UNITAR-UNOSAT and Copernicus are also available through the UNOSAT [LIVE WEB MAP](#).
More info regarding satellite analysis plan by different groups is available on [GDACS' Satellite Mapping and Coordination System \(SMCS\)](#).

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be error-free nor do they imply official endorsement or acceptance by the United Nations. 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 & development agencies & their implementing partners. This work by UNITAR-UNOSAT is licensed under a CC BY-NC 3.0.

The analysis has not been verified in the field yet; please send your comments and feedback to unosat@unitar.org.

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Update 1 : [Preliminary Satellite Based Damage Assessment Report-Update 1](#)

Update 2 : [Preliminary Satellite Based Damage Assessment Report-Update 2](#)