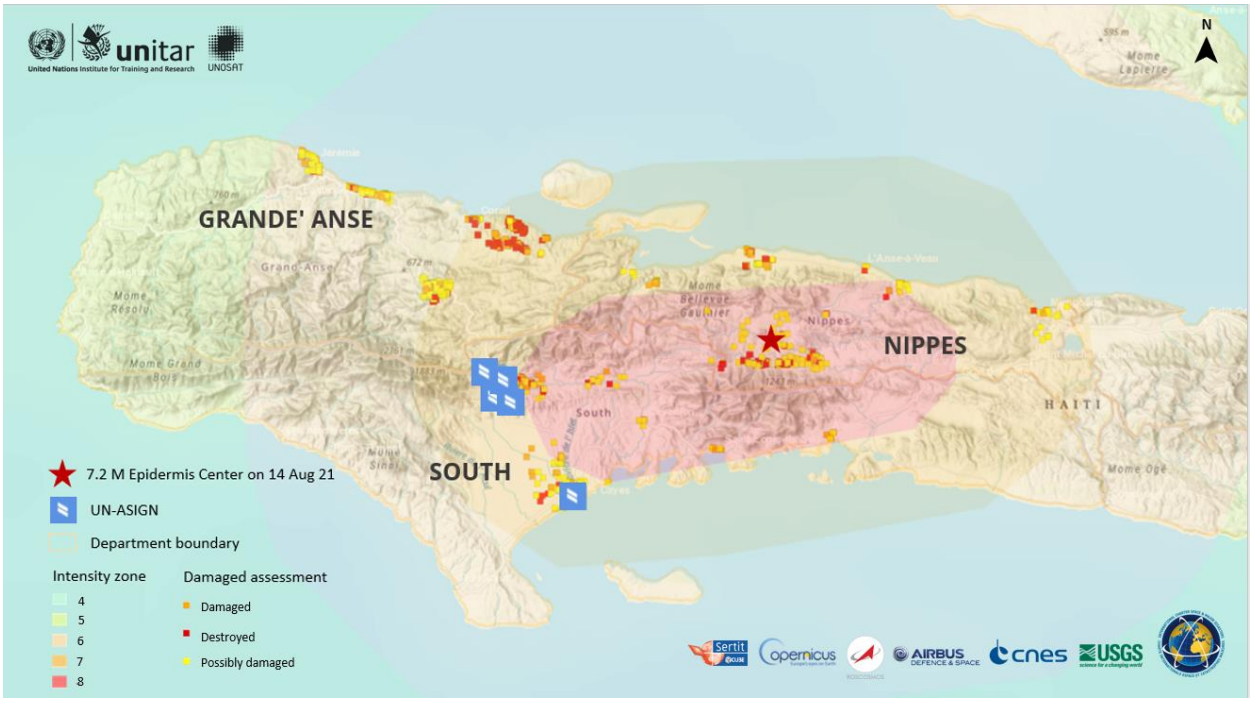
14 August 2021 M7.2 Haiti Earthquake. Preliminary Satellite-Based Comprehensive Damage Assessment Report

Grande'Anse, South, and Nippes departments of Haiti

The 27th of August 2021



Prepared By
United Nations Satellite Centre (UNOSAT)

UNOSAT Contact:
Email: unosat@unitar.org
T: +41 22 917 4720 (UNOSAT Operations)
Hotline: +41 75 411 4998

Postal Address:
UNITAR – UNOSAT, IEH
7 bis, Avenue de la Paix,
CH-1202 Geneva 2, Switzerland

Contents

Overview

A magnitude 7.2 earthquake struck Haiti on the 14th of August, 2021, causing damage, devastation, and destruction in the southwestern parts of the country. The epicentre was located about 125km west of the capital city of Port-au-Prince at a depth of about 10 kilometres (USGS).

The Haitian Civil Protection General Directorate (DGPC) has stated that 137,000 families have been affected in the South, Grande'Anse, and Nippes departments. About 500,000 people – 40% of the total population in the affected departments – need emergency humanitarian assistance.

According to the OCHA, the death toll has soared to nearly 2,200, with more than 12,000 injured and 344 people missing. More than 80 percent of these deaths are registered in the South department. These figures are likely to rise as the after-effects of the earthquake, along with the effects of Storm Grace, are fully realised. Storm Grace added 10 inches of rain to the already devastated southwestern departments. In addition, more than 52,900 homes were destroyed and 77,000 damaged.

- Preliminary assessment has shown devastating damages to houses, roads, and bridges disrupting aid movement into the affected areas.

- This report summarizes satellite analysis focused on one of the most affected areas in Haiti, specifically the South, Grande' Anse, and Nippes departments in the south-west of the country.

Comprehensive Satellite-Detected Building Damage Assessment: Overview Map, Methodology and Considerations

UNITAR-UNOSAT, on behalf of the UN Operations and Crisis Centre (UNOCC), activated the International Charter on Space and Major Disasters on the 14th of August 2021 to support the planning and coordination of emergency response operations with satellite analysis, covering the areas affected by the earthquake. Other organizations such as the Haitian Civil Protection and CENAPRED have also requested the activation of the International Space Charter. The Project Manager (PM) nominated for this Charter Call is I-Cube SERTIT, while UNOSAT, along with other satellite mapping groups (Copernicus EMS), are supporting the Charter Call by providing (satellite-derived) value-added analysis & mapping products. To support the planning and coordination of emergency response operations, UNOSAT has released a Preliminary Satellite-Based Damage Assessment report for Haiti's Nippes, Grande' Anse, and South departments. In addition, a webmap of satellite-based analysis related to the M7.2 earthquake and a damage assessment for the Nippes Department of Haiti have been released.

ICube-SERTIT and Copernicus Emergency Management Service have also been working to provide a coherent and broad overview of the damage caused by the earthquake. In addition, efforts have been made to estimate the overall damage caused by the earthquake, particularly concerning the number of damaged buildings in Haiti. This report will focus on the three most affected departments: South, Grande' Anse, and Nippes. The building damage assessment was conducted using pre and post event satellite data covering different areas of interest shown on the GDACS Satellite Mapping Coordination System (SMCS) page, a coordination platform where organisations monitor mapping activities for ongoing emergencies.

Figure 1, the snapshot of GDACS – SMCS, depicts the analysis extent and status of UNOSAT, SERTIT, and Copernicus EMS

Satellite-derived analysis

This report describes preliminary building damage analysis covering the departments of South, Grande' Anse, and Nippes of Haiti, for a total area of approximately 550 Km^2. A building damage analysis and a rapid assessment of transportation network conditions was conducted by comparing a series of satellite imageries acquired from the International Charter Space and Major Disasters, before and after the earthquake.

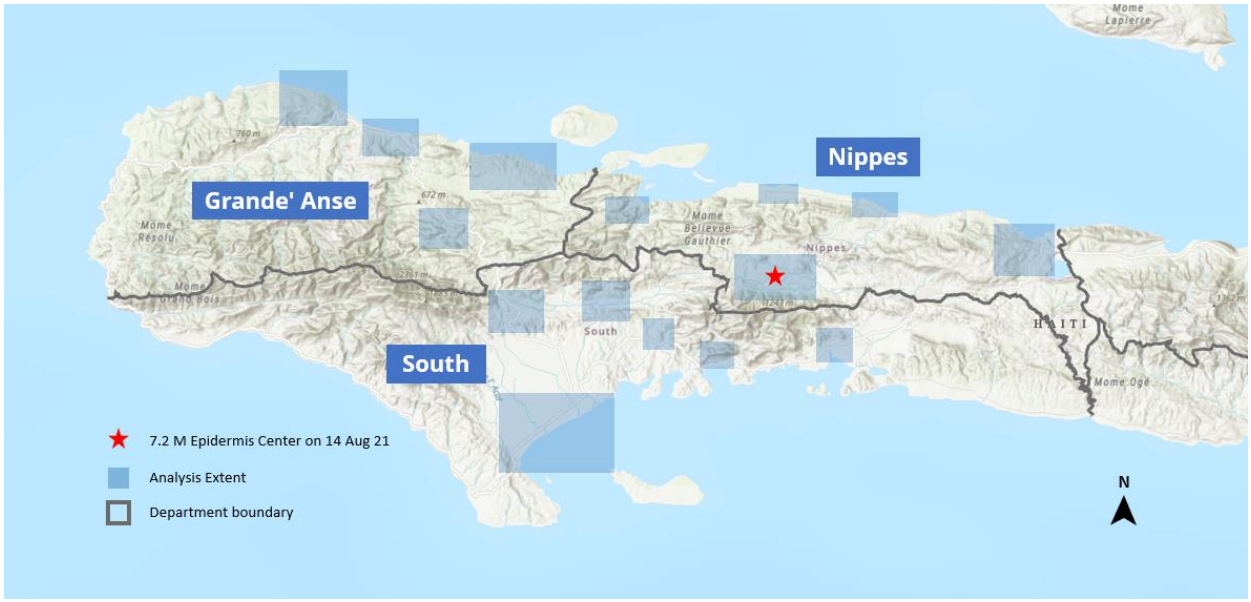


Figure 2. This map depicts the analysis extents in the Grande' Anse, South, and Nippes departments of Haiti examined by UNOSAT, SERTIT, and Copernicus EMS to determine infrastructure damage caused by the M7.2 earthquake on the 14th of August 2021. The map also identifies the earthquake epicentre in the Nippes department.

Area of interest	Pre event satellite data	Post event satellite data
Area 1, South department	1. Worlview-2, 13 Dec 2019	1. Pleaides, 15 Aug 2021
	2. Worlview-3, 18 May 2021	2. Pleaides, 20 Aug 2021
	3. Worlview-1, 4 Jan 2021	
	4. GeoEye, 27 Feb 2021	
Area 2, Grande' Anse department	1. Worlview-3, 17 Dec 2017	1. Pleaides, 15 Aug 2021
	2. Worlview-1, 2 Dec 2019	2. Pleaides, 18 Aug 2021
	4. Worlview-3, 9 Oct 2020	
	5. Worlview-2, 27 Feb 2021	
	3. Worlview-3, 17 May 2021	
Area 3, Nippes department	1. GeoEye-1, 12 Oct 2018	1. Pleaides, 15 Aug 2021
	2. Worlview-2, 13 Dec 2019	2. Pleaides, 16 Aug 2021
	3. Worlview-2, 29 Dec 2019	3. Pleaides, 18 Aug 2021
	4. Worlview-2, 5 Apr 2020	4. Pleaides, 20 Aug 2021
	5. Worldview-3, 18 May 2021	5. Worldview-3, 16 Aug 2021
		6. Worldview-1, 15 Aug 2021
		7. Worldview-2, 14 Aug 2021
		8. Worldview-2, 16 Aug 2021
		9. Worldview-3, 16 Aug2021
		10. RESURS_P, 18 Aug 2021
		11. GeoEye, 18 Aug 2021

Table 1. Overview of satellite imageries had been used for the damage assessment covering 3 analysis zones and its acquisition date

Analysis summary

The preliminary analysis extent within South, Grande' Anse, and Nippes departments identify a total of 1,842 buildings/structures with visible damages and approximately 130 locations with visible road obstacles and/or access constraints.

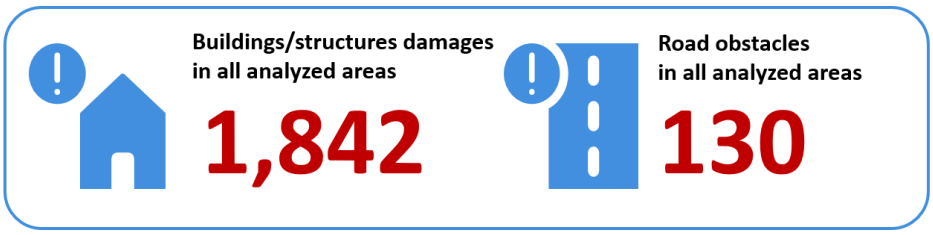


Figure 3. This map depicts the analysis extents in the Grande' Anse, South, and Nippes departments of Haiti examined by UNOSAT, SERTIT, and Copernicus EMS to determine infrastructure damage caused by the M7.2 earthquake on the 14th of August 2021.

Department	Area of Department (km^2)	Analysis Extent		Building damage assessment			Road obstacles assessment		
		Analyzed Extent (km^2)	Percentage of Area in Analyzed Extent (km^2)	Damaged Buildings	Potentially Damaged Buildings	Total of Damaged and Potentially Damaged Buildings	Road Obstacles	Potentially Road Obstacles	Total of Road Obstacles and Potentially Road Obstacles
South	1,713	182	11%	243	338	581	2	7	9
Nippes	1,095	242	22%	229	333	562	5	21	26
Grande'Anse	1,198	84	7%	343	356	699	10	85	95
Total	4,006	508	13%	815	1,027	1,842	17	113	130

Table 2. Overview of building/structure damage assessment conducted by UNOSAT, SERTIT, and Copernicus EMS. The table gives an overview of the total area and analysed area of each affected department and the potentially damaged and damaged buildings and roads identified during the analysis.

Area 1: South Department

The South department has a population of approximately 875,183 people and an area of 2,646 km^2. According to Humanitarian Open Street Map data, the pre-event building footprint of the South department was 143,153 buildings, with 63,385 of those buildings within the Areas of Interest (AOIs) analysed by emergency response teams.

Area 1 has five AOIs covering approximately 182 km^2 in seven communes, including Aquin, Camp-Perrin, Cavaillon, Les Cayes, Maniche, Saint Louis du Sud, and Torbeck. Analysts conducted satellite-analysis by comparing the post-disaster satellite images with available pre-disaster images.

UNOSAT and partners' preliminary analysis shows 581 buildings/structures with visible damages (1% of the total building in AOIs) and approximately nine locations with visible road obstacles and/or access constraints.

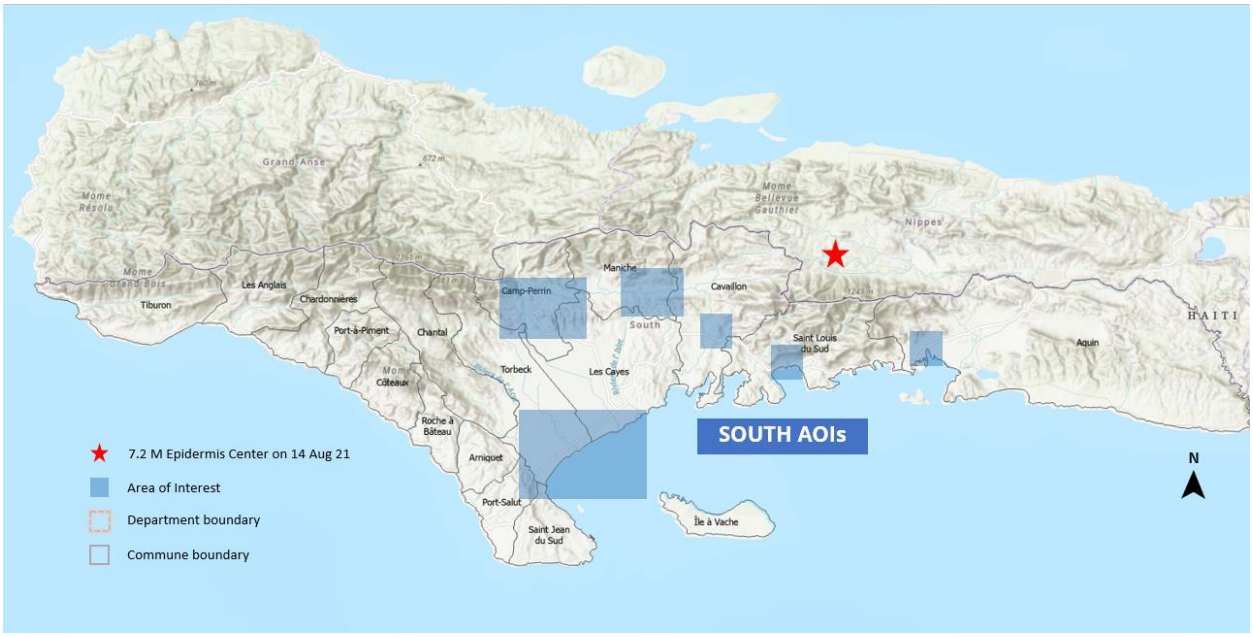


Figure 4. This map depicts the analysis extents in the South departments of Haiti examined by UNOSAT, SERTIT, and Copernicus EMS to determine infrastructure damage caused by the M7.2 earthquake on the 14th of August 2021.

Department/Commune	Area of Commune/ Department (km^2)	Analysis Extent		Building damage assessment			Road obstacles assessment		
		Analyzed Extent (km^2)	Percentage of Area in Analyzed Extent (km^2)	Damaged Buildings	Potentially Damaged Buildings	Total of Damaged and Potentially Damaged Buildings	Road Obstacles	Potentially Road Obstacles	Total of Road Obstacles and Potentially Road Obstacles
South	**1,713**	**182**	**11%**	**243**	**338**	**581**	**2**	**7**	**9**
Aquin	637	4	1%	4	5	9	1	2	3
Camp-Perrin	127	24	19%	60	66	126	-	-	-
Cavaillon	229	15	6%	3	11	14	-	2	2
Les Cayes	218	116	53%	147	196	343	1	3	4
Maniche	130	20	15%	10	10	20	-	-	-
Saint Louis du Sud	183	1	1%	17	49	66	-	-	-
Torbeck	189	2	1%	2	1	3	-	-	-

Table 3. Overview of building/structure damage assessment in the South department. The table gives an overview of the total area and analysed area of each affected commune of the department and the potentially damaged and damaged buildings and roads identified during the analysis.

Building/Structure damage assessment in South Department

Preliminary building/structure damage assessments were conducted through visual interpretation by UNOSAT and partners, utilising before and after very high-resolution satellite images. The post-disaster satellite images were acquired after the earthquake on the 14th of August 2021, along with available pre-disaster images. A total of 581 buildings were identified with prominently visible damage within the analysed areas. Les Cayes commune had the highest number of affected buildings, with over 340 damaged buildings detected.

Figure 5. This map depicts the extent of damaged buildings in the South department of Haiti, specifically in the Les Cayes, Cavaillon, Camp-Perrin, Maniche, Saint Louis du Sud, and Aquin communes. Additional inset images from WorldView-3 and Pleiades satellite acquired on the 15th of August 2021 highlight and visualise the extent of damage to buildings within Les Cayes and Cavaillon communes.

Area 2: Grande' Anse department

Grande' Anse has a population of approximately 615,714 people and an area of 1,913km^2. According to Humanitarian Open Street Map data, the pre-event building footprint of the Grande' Anse department was 84,125 buildings, with 50,140 of those buildings within the areas of Interest (AOIs) analysed by emergency response teams.

Area 2 has four AOIs covering approximately 84 km^2 in five communes, including Beaumont, Corail, Jeremie, Pestel, and Roseaux. Analysts conducted satellite-analysis by comparing the post-disaster satellite images with available pre-disaster images.

UNOSAT and partners' preliminary analysis identifies a total of 699 buildings/structures with visible damages (2% of the total building in AOIs) and approximately 95 locations with visible road obstacles and/or access constraints.

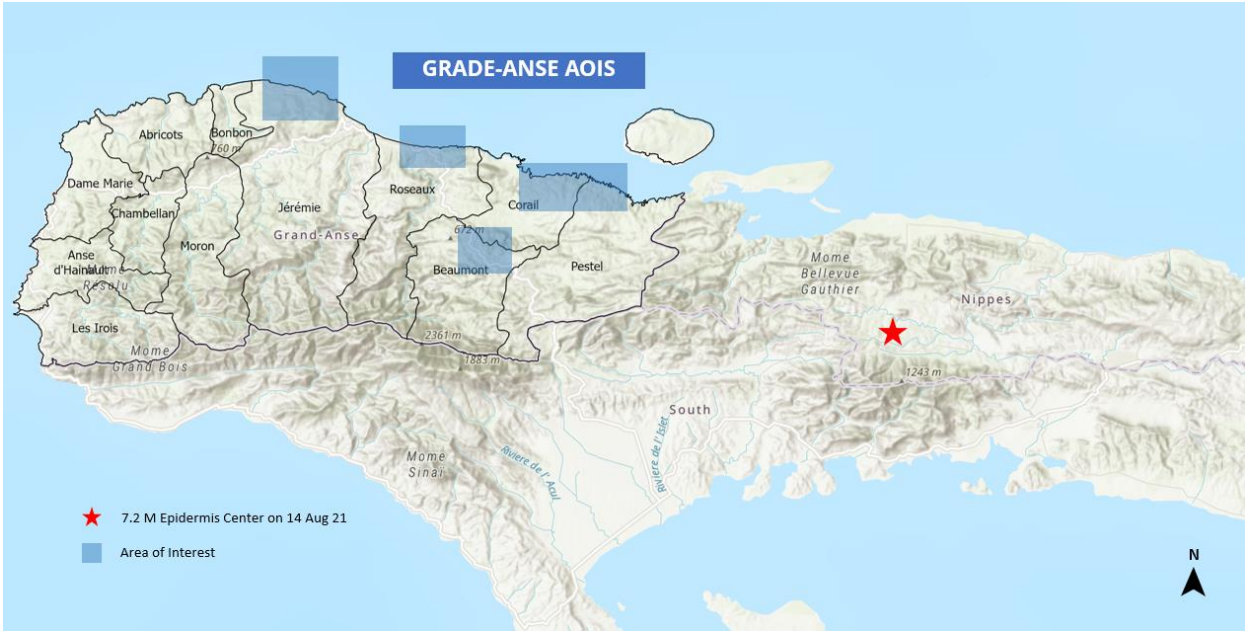


Figure 6. This map depicts the analysis extent in the Grande' Anse departments of Haiti examined by UNOSAT, SERTIT, and Copernicus EMS to determine infrastructure damage caused by the M7.2 earthquake on the 14th of August 2021.

Department/Commune	Area of Commune/ Department (km^2)	Analysis Extent		Building damage assessment			Road obstacles assessment		
		Analyzed Extent (km^2)	Percentage of Area in Analyzed Extent (km^2)	Damaged Buildings	Potentially Damaged Buildings	Total of Damaged and Potentially Damaged Buildings	Road Obstacles	Potentially Road Obstacles	Total of Road Obstacles and Potentially Road Obstacles
Grande'Anse	**1,198**	**84**	**7%**	**343**	**356**	**699**	**10**	**85**	**95**
Beaumont	168	14	8%	77	239	316	1	13	14
Corail	108	20	19%	74	12	86	1	42	43
Jeremie	418	18	4%	23	22	45	-	-	-
Pestel	291	25	9%	124	10	134	7	29	36
Roseaux	213	7	3%	45	73	118	1	1	2

Table 4. Overview of building/structure damage assessment in Grande' Anse department. The table gives an overview of the total area and analysed area of each affected commune of the department and the potentially damaged and damaged buildings and roads identified during the analysis.

Building/Structure damage assessment in Grande' Anse department

Preliminary building/structure damage assessment was conducted through visual interpretation by UNOSAT and partners utilizing before and after very high-resolution satellite imageries. The post-disaster satellite images were acquired after the earthquake on the 14th of August 2021 with available pre-disaster images. A total of 699 buildings were identified to have suffered prominently visible damages within the analysed areas. Beaumont commune had the highest number of affected buildings, with over 300 damaged buildings detected.

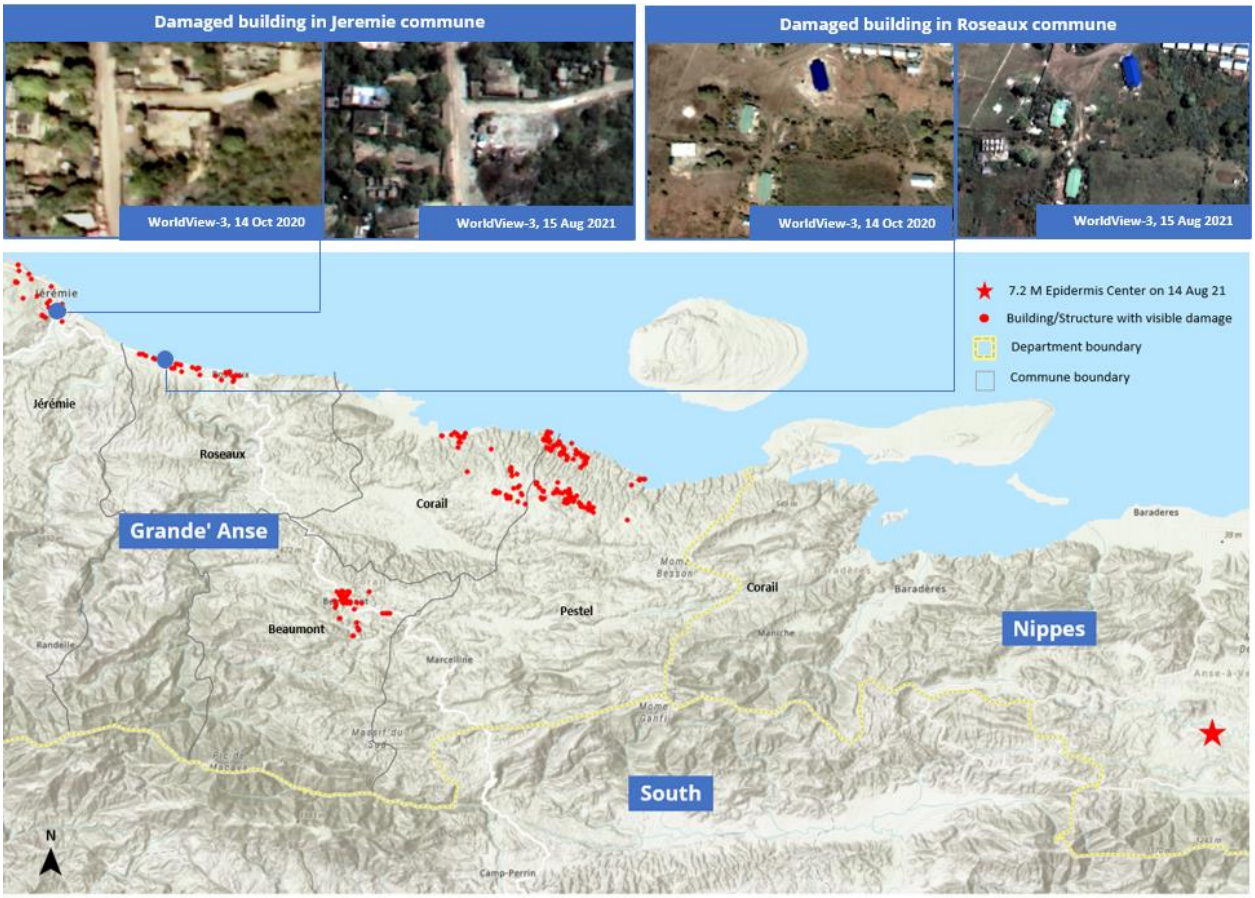


Figure 7. This map depicts the extent of damaged buildings in Grande' Anse department of Haiti, specifically in the Jeremie, Roseaux, Corail, Beaumont, and Pestel communes. Additional inset images from the WorldView-3 satellite acquired on the 15th of August 2021 highlight and visualise the extent of damage to buildings within Les Cayes and Cavaillon communes.

Area 3: Nippes department

Nippes has a population of approximately 446,079 people and an area of 1,226km^2. According to Humanitarian Open Street Map data, the pre-event building footprint of the Nippes department was 18,980 buildings, with 18,403 of those buildings within the areas of interest (AOIs) analysed by emergency response teams.

Area 3 has five AOIs covering approximately 242 km^2 in nine communes including Anse-a-Veau, Arnaud, Baraderes, L'Asile, Miragoane, Paillant, Petit Trou de Nippes, Petite Riviere de Nippes and Plaisance du Sud. Analysts conducted satellite-analysis by comparing the post-disaster satellite images with available pre-disaster images.

UNOSAT and partners' preliminary analysis identifies a total of 562 buildings/structures with visible damages (3% of the total building in AOIs) and approximately 26 locations with visible road obstacles and/or access constraints.

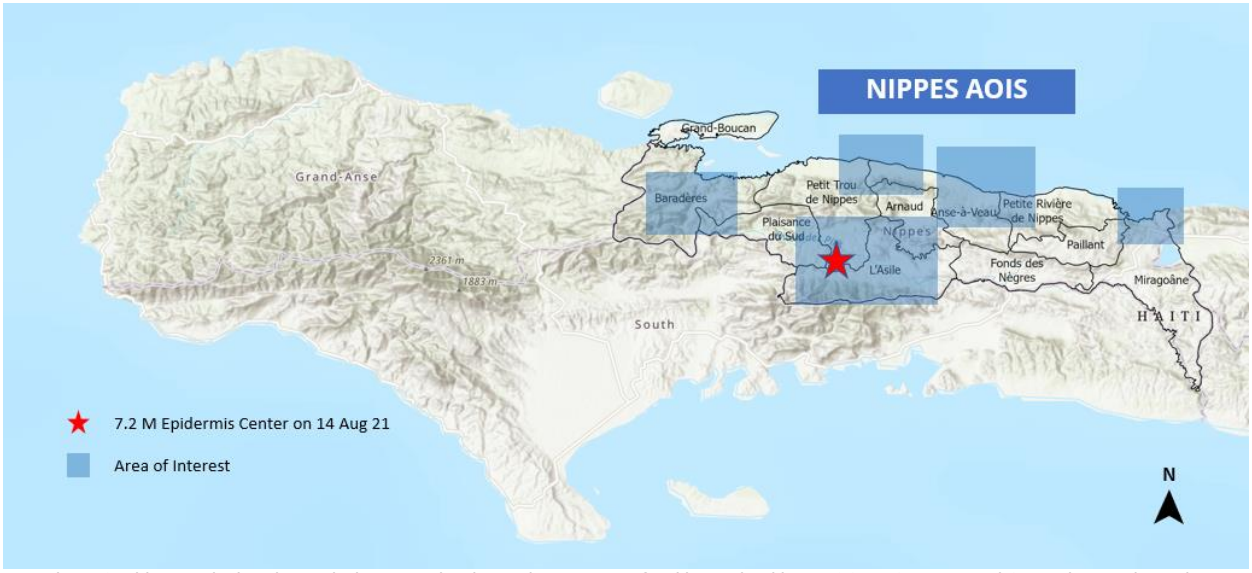


Figure 8. This map depicts the analysis extents in Nippes departments of Haiti examined by UNOSAT, SERTIT, and Copernicus to determine infrastructure damage caused by the M7.2 earthquake on the 14th of August 2021. The map also identifies the earthquake epicentre, which is also situated within the department.

Department/Commune	Area of Commune/ Department (km^2)	Analysis Extent		Building damage assessment			Road obstacles assessment		
		Analyzed Extent (km^2)	Percentage of Area in Analyzed Extent (km^2)	Damaged Buildings	Potentially Damaged Buildings	Total of Damaged and Potentially Damaged Buildings	Road Obstacles	Potentially Road Obstacles	Total of Road Obstacles and Potentially Road Obstacles
Nippes	**1,095**	**242**	**22%**	**229**	**333**	**562**	**5**	**21**	**26**
Anse-a-Veau	107	27	25%	6	11	17	-	-	-
Arnaud	74	5	6%	1	1	2	-	-	-
Baraderes	186	24	13%	17	52	69	-	-	-
L'Asile	157	55	35%	129	180	309	3	14	17
Miragoane	170	33	19%	4	16	20	-	1	1
Paillant	66	10	15%	-	-	-	-	-	-
Petit Trou de Nippes	154	52	33%	64	62	126	2	5	7
Petite Riviere de Nippes	90	3	3%	-	-	-	-	-	-
Plaisance du Sud	91	34	37%	8	11	19	-	1	1

Table 5. Overview of building/structure damage assessment in Nippes department. The table gives an overview of the total area and analysed area of each affected commune of the department and the potentially damaged and damaged buildings and roads identified during the analysis.

Building/Structure damage assessment in Nippes department

Preliminary building/structure damage assessment was conducted through visual interpretation by UNOSAT and partners utilising before and after very high-resolution satellite imagery. The post-disaster satellite images were acquired after the earthquake on the 14th of August 2021 with available pre-disaster images. A total of 562 buildings were identified with prominently visible damage within the analysed areas. L'Asile commune had the highest number of affected buildings, with over 300 damaged buildings detected.

Figure 9. This map depicts the extent of damaged buildings in the Nippes department, specifically in the Baradères, Plaisance du Sud, Petit Trou de Nippes, L'Asile, Arnaud, Anse-à -Veau and Miragoane communes. Additional inset images from the Pleiades satellite acquired on the 15th of August 2021 highlight and visualise the extent of damage to buildings within Les Cayes and Cavaillon communes.

UNOSAT LIVE Web map

UNOSAT Live maps are created by the United Nations Satellite Centre (UNOSAT) and deliver an overview of a situation by providing information on damage assessments conducted by the UN Satellite Centre and partner organisations (SERTIT, Copernicus EMS, etc.). They share their analysis results in a geographic format on the web map. Additionally, the web map hosts imagery and information from the UN-ASIGN application, which provides on-the-ground details of a situation from the perspective of citizens and humanitarian staff. It delivers a comprehensive overview of a disaster situation by displaying information from satellite-derived observations and field imagery. The added benefit of the live web map is the ability to host data from different data sources and deliver up-to-date information publicly available across browsers and operating systems by citizens and emergency staff alike.

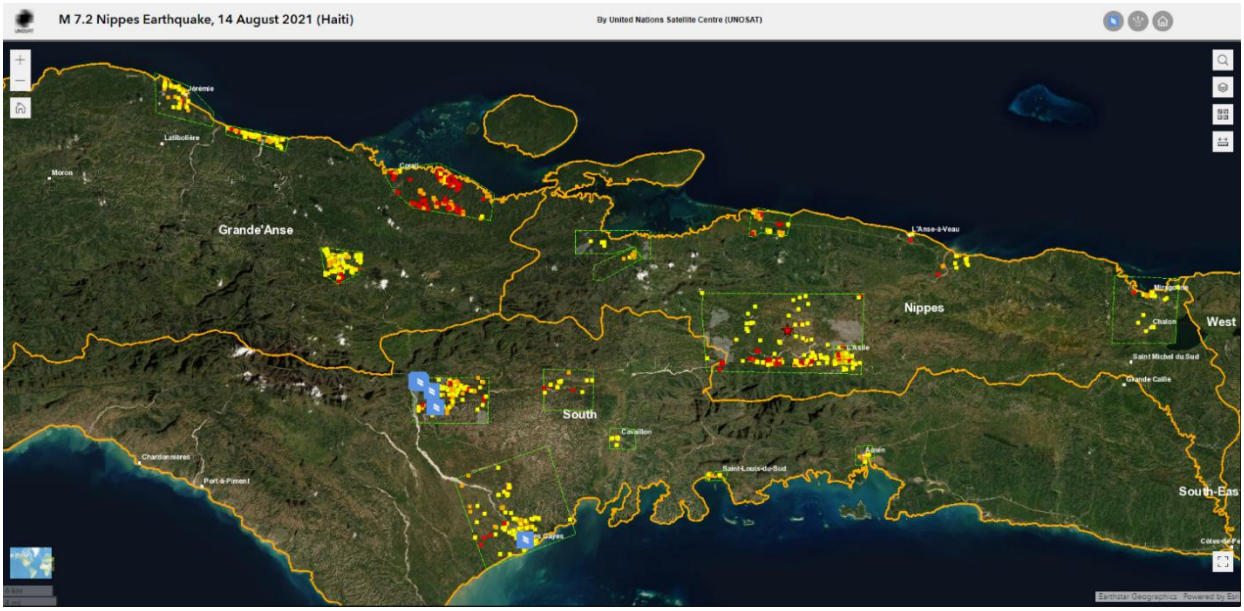


Figure 10. A snapshot of the UNOSAT web map interface displaying areas identified as damaged (red and orange) and potentially damaged (yellow) following the M7.2 Haiti earthquake in all analysed areas (green). The image additionally shows the georeferenced images from UN-ASIGN, which have been synchronised with the web map.

UNASIGN

UN-ASIGN was developed for the United Nations as a disaster management tool to help volunteers and the general public provide observations during an emergency or crisis. Geo-tagged images uploaded onto the UN-ASIGN application allow the UN to improve situational awareness and help agencies working in a disaster or emergency evaluate a crisis. Additionally, complimentary imagery to satellite earth observations can deliver a comprehensive and in-depth overview of a situation.

The UN-ASIGN app is combined with the UN live mapping tool to support the emergency decision making process, particularly in the critical early stages following a disaster. The image inputs are integrated into the online mapping tool, which is publicly available and displays geospatial data from various sources. As a UN Information Management tool, the application has the added value of being configured to work under challenging communication conditions to deliver accurate and vital information as soon as possible. The imagery and information inputted with UN-ASIGN can often provide information that cannot be identified through usual satellite imagery analysis, such as the extent of building damage on a structure covered by roofing structures or vegetation (Figure X).

The UN-ASIGN app can be downloaded on Android or Apple.

Figure 11. UN-ASIGN application interface for download on both Apple and Android devices, respectively.

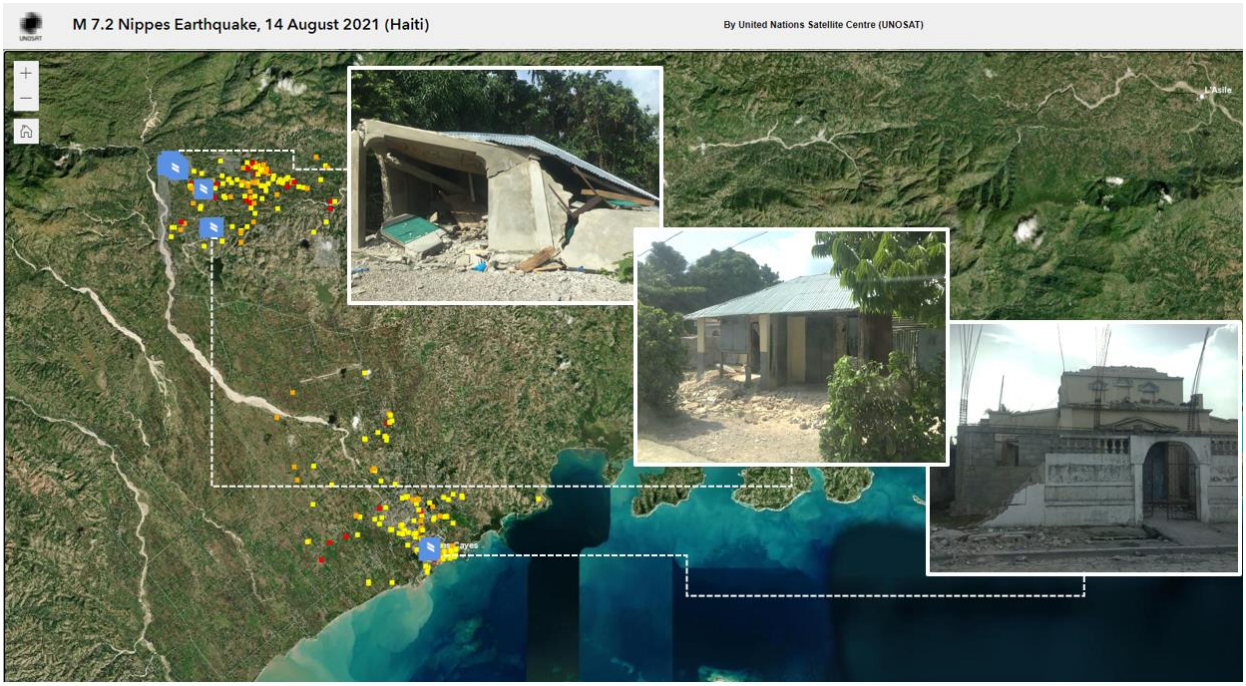


Figure 12. UN-ASIGN images displayed on the UNOSAT live web map showing damaged structures in the South department, Haiti, following the M7.2 earthquake

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 plans by different groups is available on

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

UNOSAT Contact:
Email: unosat@unitar.org
T: +41 22 917 4720 (UNOSAT Operations)
Hotline: +41 75 411 4998

Postal Address:
UNITAR – UNOSAT, IEH
7 bis, Avenue de la Paix,
CH-1202 Geneva 2, Switzerland