

Thematic Session: IT Innovations

# Geospatial Approaches to Damage Assessment: The Example of Haiti Earthquake

Date: 10/05/2011

Location: Geneva, Switzerland

Name: Luca Dell'Oro

Title: Research Associate

Organization: UNITAR-UNOSAT



Recovering and Reducing Risks after Natural Disasters



**GFDRR**  
Global Facility for Disaster Reduction and Recovery



**ISDR**



Global Platform  
for Disaster Risk Reduction





**unitar**

United Nations Institute for Training and Research



- *United Nations Institute for Training and Research*
- ***Mission:*** To deliver innovative training and conduct research on knowledge systems to develop the capacity of beneficiaries in the fields of **Environment; Peace-Security and Diplomacy, Governance and Research**

# UNOSAT

- **UNOSAT** is the Operational Satellite Applications Programme of the United Institute of Training and Research (UNITAR)
- **Goal:** to make satellite analysis/solutions and geographic information easily accessible to the UN, local governments, international organizations and NGOs



**unitar**

United Nations Institute for Training and Research





## UNOSAT's three main operational areas



### Humanitarian Aid and Relief Coordination

- Crisis & Situational Mapping
- Damage assessment



### Human Security

- Conflict Monitoring
- Human Rights
- Damage Assessment

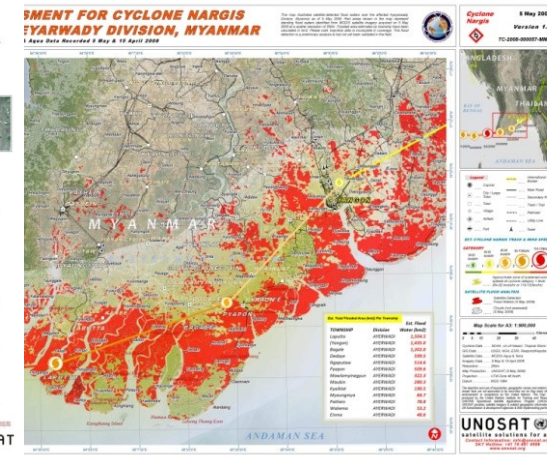
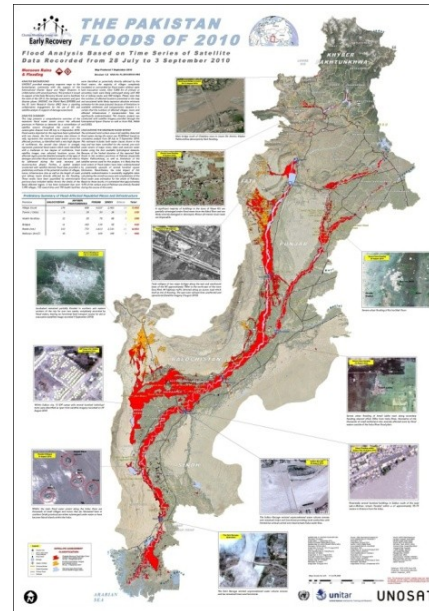


### Territorial Planning and Environmental Monitoring

- Capacity Development & Technical Assistance
- In-country project development

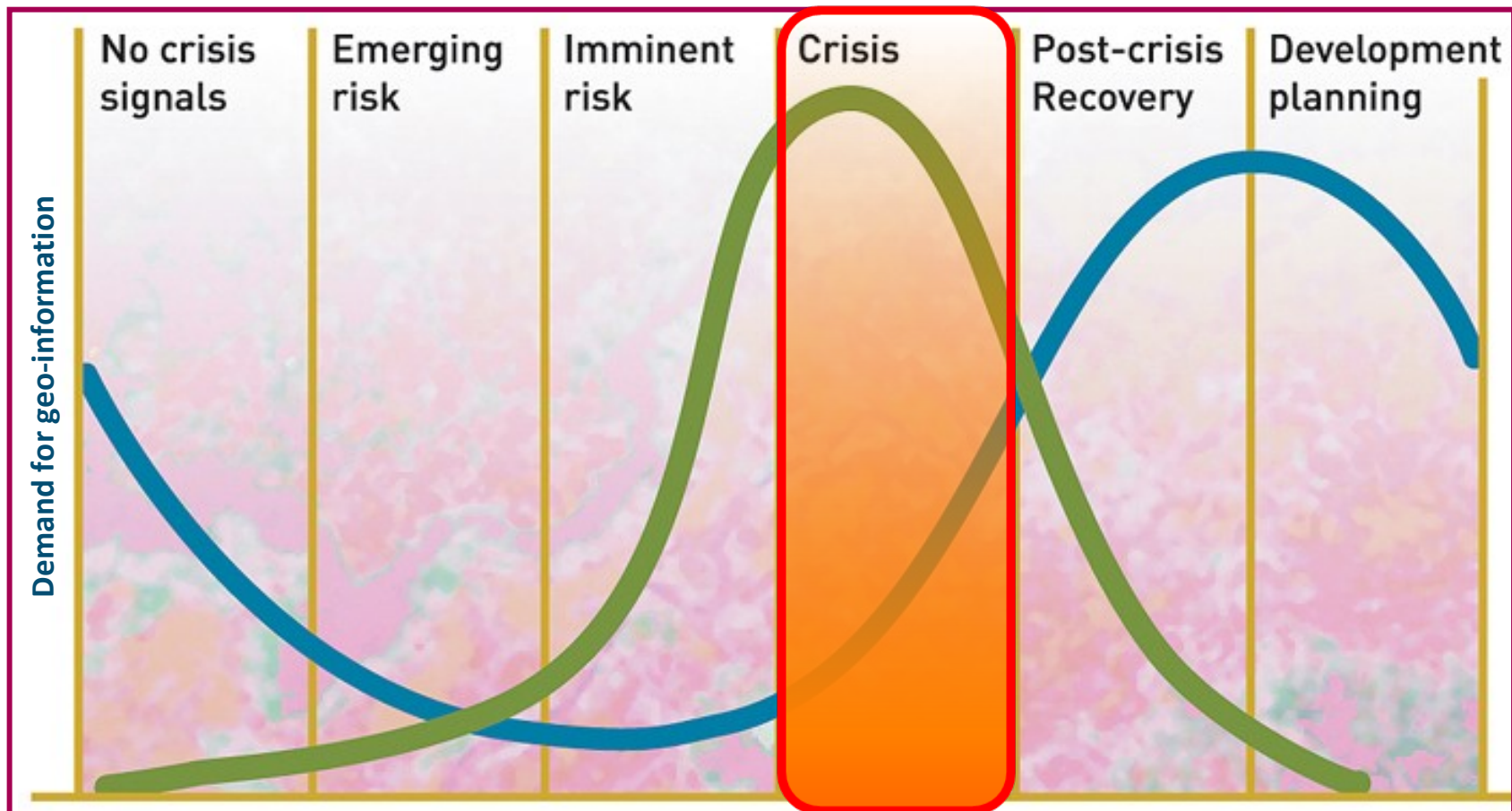
Satellite based Analysis and Mapping

- UNOSAT mapping Covers major conflicts and all types of disasters: 35 events per year
- Tasked since Jan. 2003 in over **200 emergencies & conflicts;**
- UNOSAT means:
  - Over **1000 maps/analyses,**
  - **2 Million map downloads,**
  - **Professional training & Capacity Building**





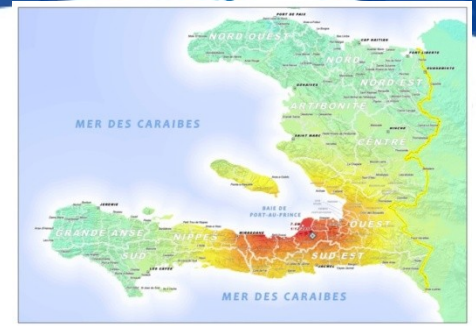
# Crucial Role Of Geo-Information in Disaster Response



Rush demand of basemap

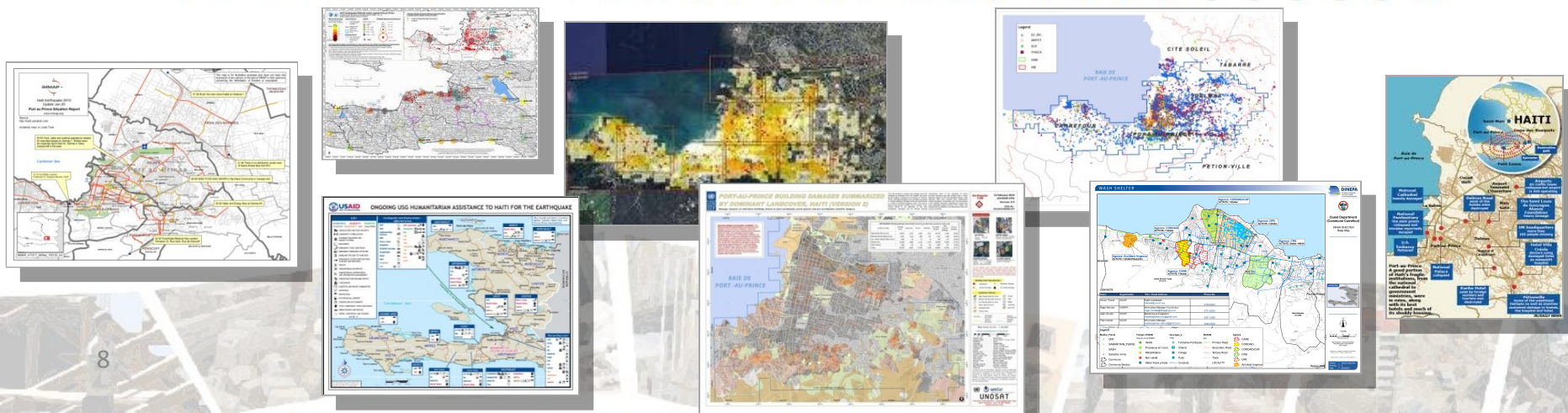
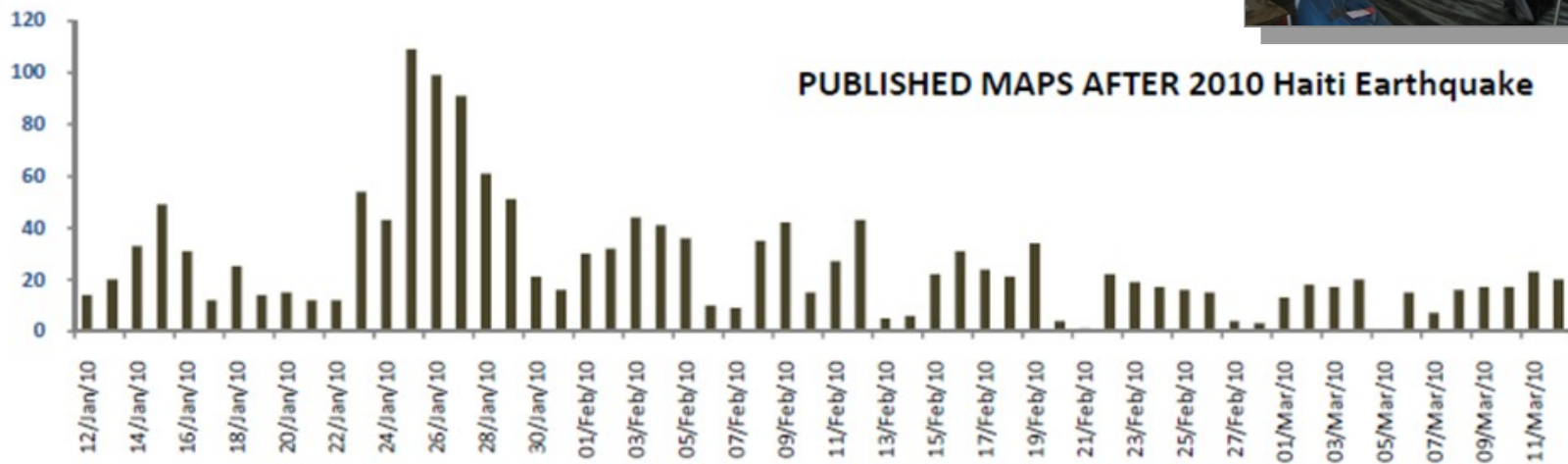
Complex info with added value

# The Haiti Earthquake (12/01/2010)



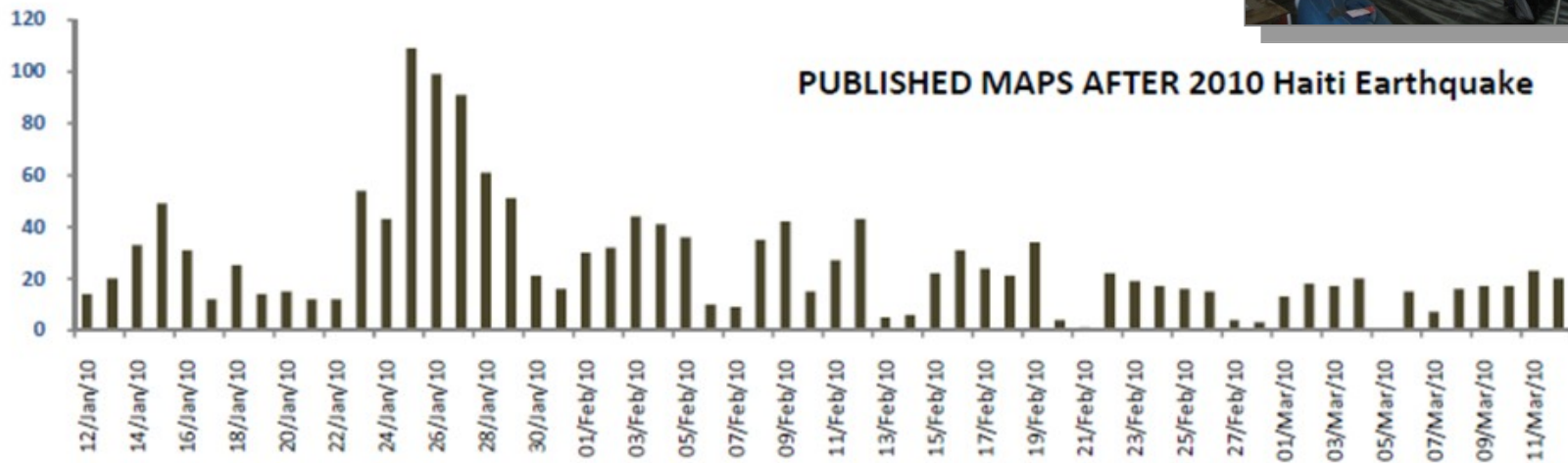


Thousands of GI related products produced by over 50 different organizations...





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# Haiti EQ: UNOSAT Geospatial Products (Timeframe)

Situation maps  
Preliminary DA

UN-EC-WB  
Comprehensive DA  
and Joint Blds DA Atlas

UNOSAT/JRC/WB  
combined GIS database

Field Validation (UNOSAT- CNIGS- JRC)

Flash  
Appeal

PDNA

S. Dom.  
Conf.

NY  
Conf.

Haiti EQ

12 Jan.

22 Jan.

18 Feb.

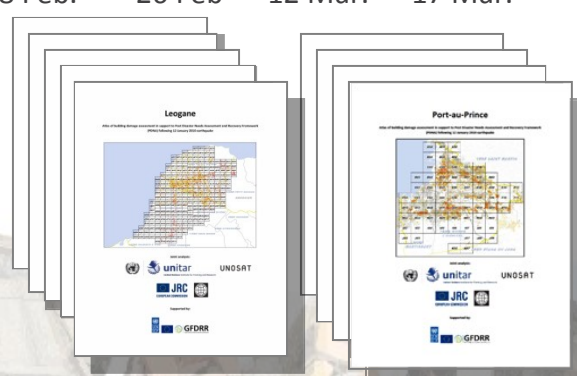
26 Feb

12 Mar.

17 Mar.

31 Mar.

April





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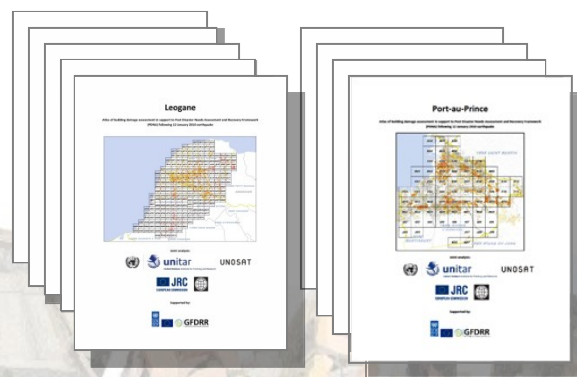
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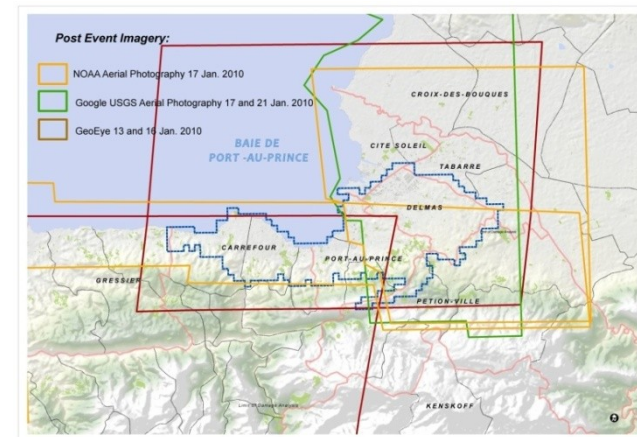
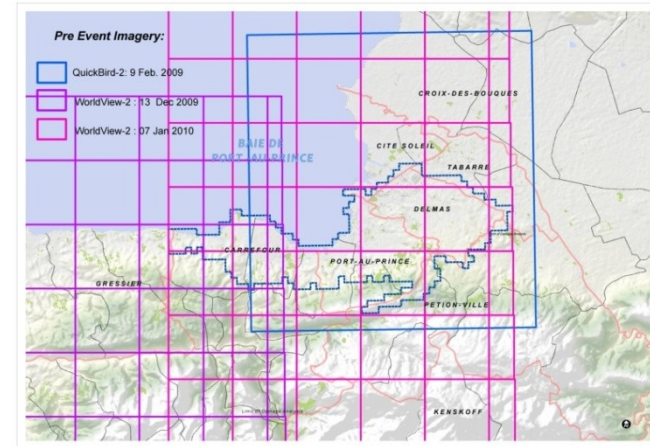


# UNOSAT methodological approach for Remote Sensing based building damage analysis:

*Pre-Disaster  
Sat. Image*








*Post-Disaster  
Aerial Photo*





# UNOSAT methodological approach for Remote Sensing based building damage analysis:

European Macro-seismic Scale-98 (EMS-98) definition:

Classification of damage to masonry buildings	
	Grade 1: Negligible to slight damage (no structural damage, slight non-structural damage) Hair-line cracks in very few walls. Fall of small pieces of plaster only. Fall of loose stones from upper parts of buildings in very few cases.
	Grade 2: Moderate damage (slight structural damage, moderate non-structural damage) Cracks in many walls. Fall of fairly large pieces of plaster. Partial collapse of chimneys.
	Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage) Large and extensive cracks in most walls. Roof tiles detach. Chimneys fracture at the roof line. Failure of individual non-structural elements (partitions, gable walls).
	Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage) Serious failure of walls; partial structural failure of roofs and floors.
	Grade 5: Destruction (very heavy structural damage) Total or near total collapse.



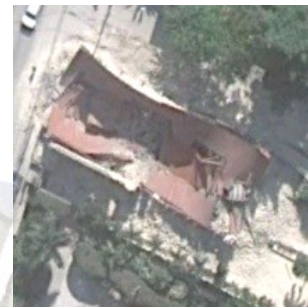
**GRADE 1: No visible damage**



**GRADE 4: Very heavy damage**



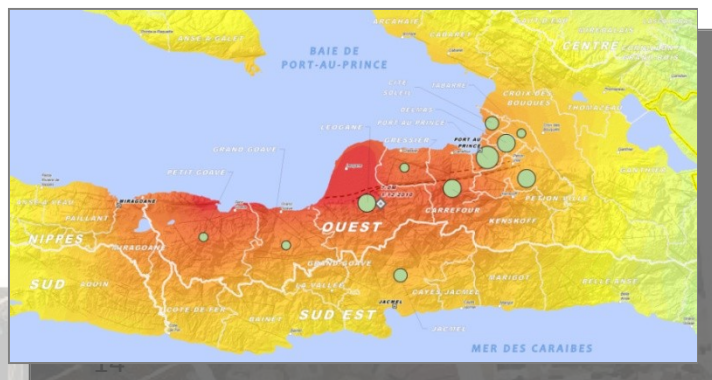
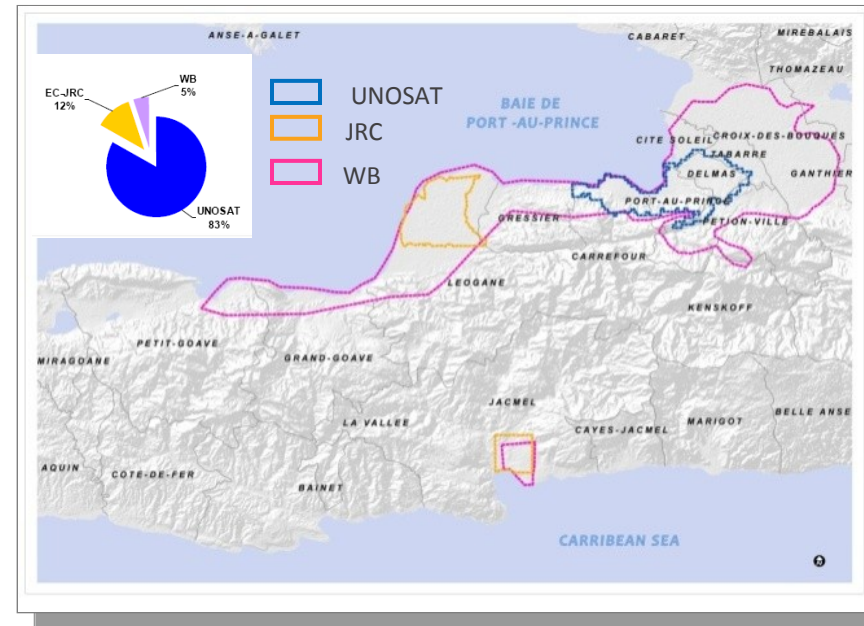
**GRADE 3: Substantial to heavy damage**



**GRADE 5: Destruction**

• **WB, EC-JRC and UNOSAT** worked jointly to provide for the **Post Disaster Needs Assessment (PDNA) process** a comprehensive atlas of blds damage assessment.

- **300,000** assessed buildings.
- **67,000** identified as damaged (Grade 4 and 5 on the EMS-98 scale).

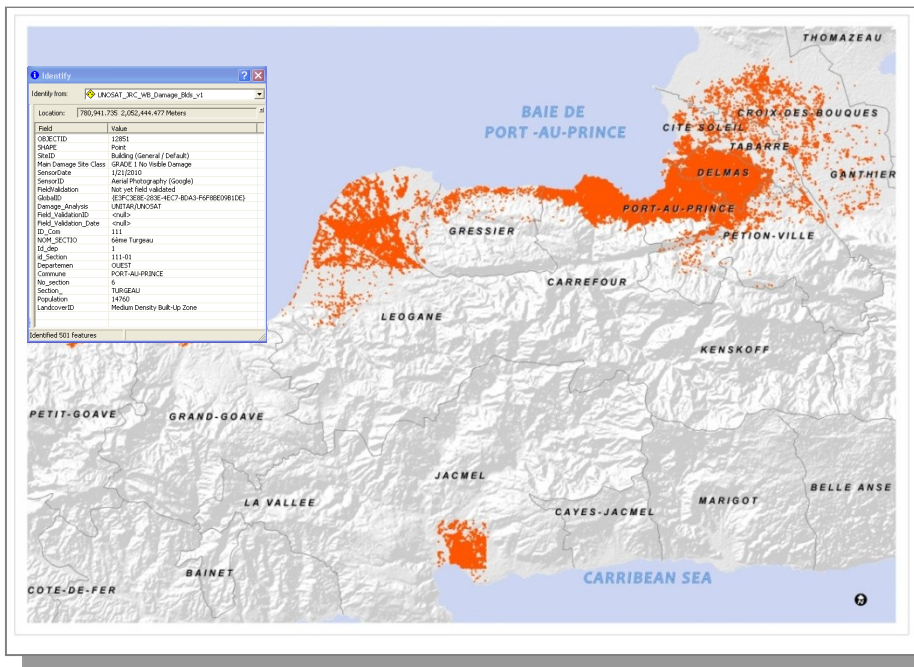


Assessed Commune	Damaged Buildings
PORT-AU-PRINCE	27,703
CARREFOUR	9,414
LEOGANE	8,891
DELMAS	8,599
PETION-VILLE	6,204
JACMEL	2,099
CITE SOLEIL	1,993
TABARRE	1,170
GRESSIER	913
PETIT-GOAVE	408
GRAND-GOAVE	270
<b>Total</b>	<b>67,664</b>





# UNOSAT – JRC – WB combined DA-GIS database




## RESEARCH

### UNOSAT

- Home
- Who we are
- What we do
- Achievements
- Collaborations
- Maps
- Haiti Data
- Sudan Data
- North Africa Data
- Training
- Contact UNOSAT

## Haiti Earthquake 2010: Remote Sensing based Building Damage Assessment Data



### Introduction

This page contains links to building damage assessment GIS datasets and corresponding PDF atlas series in support to the Post Disaster Needs Assessment and Recovery Framework (PDNA) carried out under the lead of the Government of Haiti following the 12 January 2010 Haiti earthquake.

Atlas series and GIS datasets are freely available for download as the result of a joint collaboration between: Centre National de l'Information Géographique (CNIIGS) Haiti, United Nations Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT), the European Commission Joint Research Centre (EC-JRC) and The World Bank (WB) who worked jointly in support of the PDNA by providing remotely sensed (aerial photographs and satellite imagery) based damage analysis of buildings within areas most affected by the earthquake.

**Digital data available for download**

**IMPORTANT:** before downloading GIS datasets and atlases, please refer to and download the **read-me** file.

*This is a damage assessment based on satellite imagery and aerial photos. The work was carried out on a best effort basis within a strict time frame and should be used being aware of the resulting limitations. Omissions and class confusion may occur in the dataset.*

- A Geodatabase package that contains a building damage feature dataset with associated attribute fields stored within an ESRI format file geodatabase (v. 9.3.1)  
<http://www.unosat.org/asp/getfileF.asp?pid=1>, 15.8MB
- A Shapefile package that contains building damage points with associated attribute fields  
<http://www.unosat.org/asp/getfileF.asp?pid=2>, 5.72MB

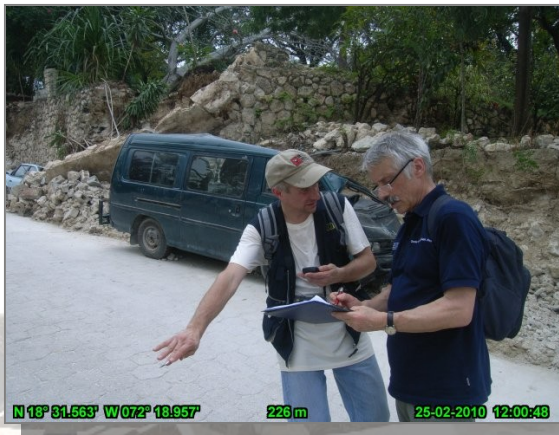
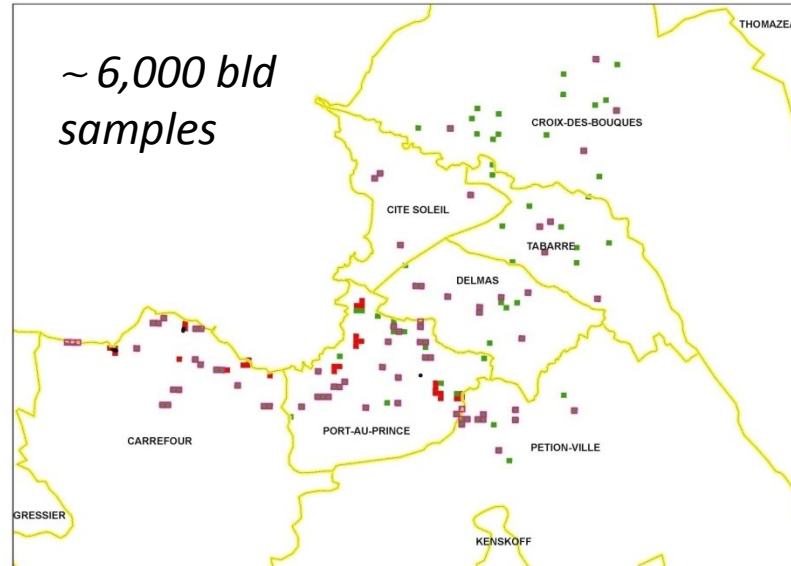
**Building Damage Assessment Atlas series for the following 11 most affected communes**

- Carrefour atlas of building damage assessment, 155.6MB
- Cite Soleil atlas of building damage assessment, 150.4MB
- Delmas atlas of building damage assessment, 225.3MB
- Grand Goave atlas of building damage assessment, 24.2MB
- Gressier atlas of building damage assessment, 181.0MB
- Jacmel atlas of building damage assessment, 101.2MB
- Leogane atlas of building damage assessment, 416.5MB
- Petit Ville atlas of building damage assessment, 601.1MB
- Petit Goave atlas of building damage assessment, 39.7MB
- Port-au-Prince atlas of building damage assessment, 164.9MB
- Tabarre atlas of building damage assessment, 273.0MB

When using this dataset, or parts of it, the source should be cited as: **"Remote sensing damage assessment: UNITAR/UNOSAT, EC JRC and World Bank"**.

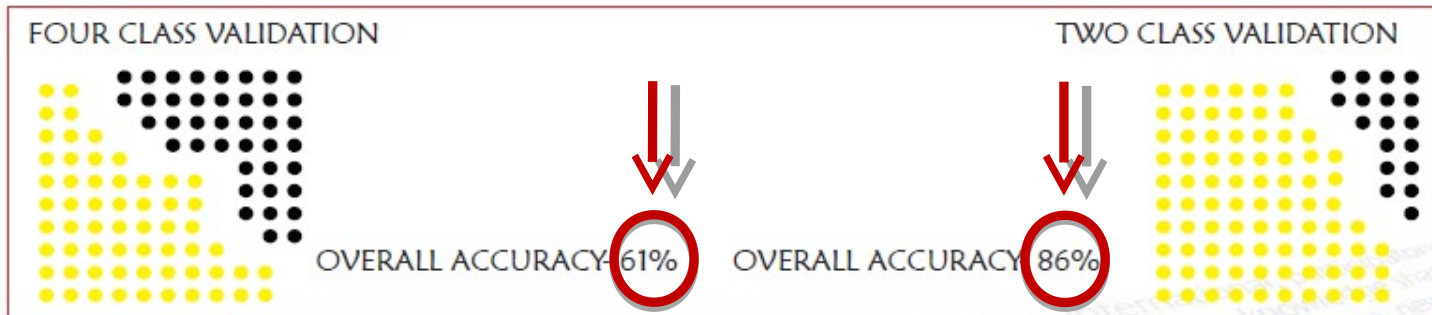
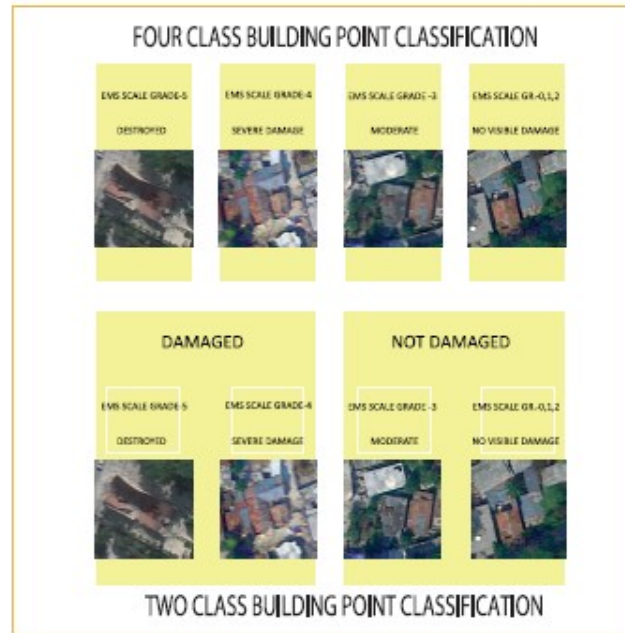
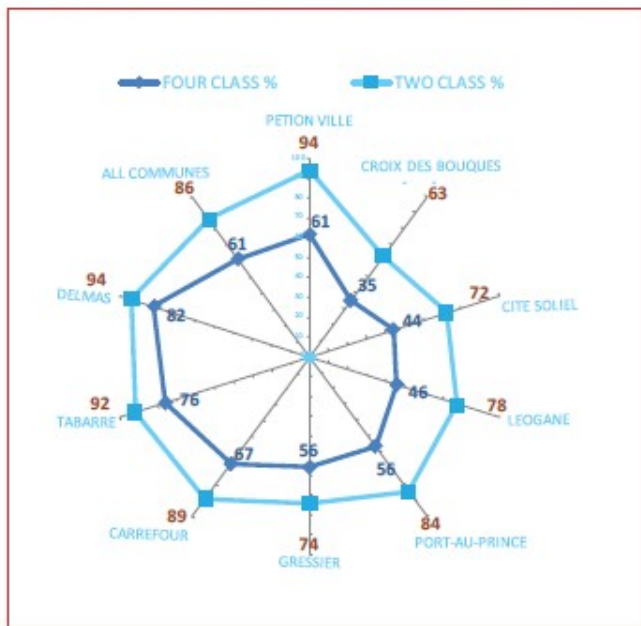
Questions and feedbacks concerning these map products and GIS datasets may be directed to UNITAR/UNOSAT at [joint-assessment-haiti@unosat.org](mailto:joint-assessment-haiti@unosat.org)

# •Field Validation Activities





# Accuracy Assessment Results: 4 and 2 damage classes Validation





## Lessons Learnt:

- ***Availability of suitable imagery, pre-disaster baseline GIS datasets*** (e.g. census, building footprints, roads, critical facilities, landcover/landuse, etc..) ***is a key to improve*** and to speed up **Remote Sensing based damage analysis**.
- ***Remote Sensing imagery has still some limitations*** for assessing different levels of building damages...(spatial resolution, angle of acquisition ,etc..) but with the fast improvements in RS technology they will be reduced..







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- **Crow sourcing is very important** for primary and secondary data collection but **expertise in analysis is needed** to make good use of it



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- **Availability of suitable imagery, pre-disaster baseline GIS datasets** (e.g. census, building footprints, roads, critical facilities, landcover/landuse, etc..) **is a key** to improve and to speed up RS based damage analysis.
- **RS imagery has still some limitations** for assessing different levels of building damages...(spatial resolution, angle of acquisition ,etc..) but with fast improvements in RS technology they will be reduced..
- **Crow sourcing is very important** for primary and secondary data collection but **expertise in analysis is needed** to make good use of it.
- **UNOSAT-JRC-WB** are working together on the **definition of standards and validation methods (SOPs)** to conduct collaborative Remote Sensing based damage assessment.