



## Plenary: Multidisciplinary Perspective on the 2010 Haiti Earthquake



**A NEW CHAPTER IN RAPID DAMAGE ASSESSMENT :  
USING TECHNOLOGY & THE POWER OF THE CROWD**

Annual Workshop 2010

7/12/2010



Shubharoop Ghosh  
Vice President, ImageCat

7/12/2010

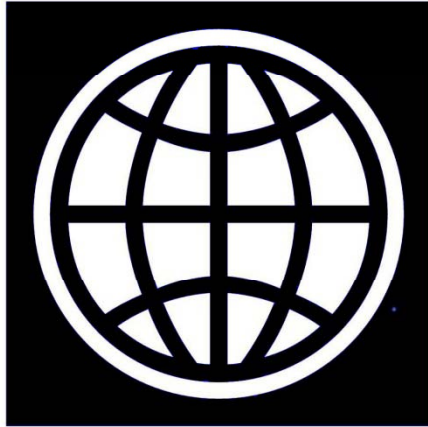
# Evaluative Lessons

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- ▶ #1 Collaboration among international hazard community
- ▶ #2 Power of the crowd- operation GEO-CAN
- ▶ #3 Novelty of 21<sup>st</sup> century response

# Global Response by an International Community

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



**unitar**  
United Nations Institute for Training and Research



**JRC**  
EUROPEAN COMMISSION



# Global Response by an International Community

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## Other collaborators:

OCHA

GEO-CAN

CNES

DLR

RIT

EERI

- OSM

- ImageCat

- SERTIT

- ITHACA

- Cambridge

- EEFIT

# Final Joint Database & Atlas, PDNA Report

- ▶ Joint GIS Database – WB, EC(JRC) and UNOSAT/UNITAR
- ▶ Haiti Damage Atlas
- ▶ Post Disaster Needs Assessment (PDNA) report



# Power of the Crowd: Operation GEO-CAN\*

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Who were the crowd

How did we reach the crowd

What did the crowd do

How did they do it

What was the end result



\* Global Earth Observation- Catastrophe Assessment Network

[www.cooltownstudios.com](http://www.cooltownstudios.com)

# Power of the Crowd: Operation GEO-CAN

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- ▶ Over 600 individuals from 23 countries
- ▶ 60 universities
- ▶ 18 government agencies and non-profit organizations
- ▶ 53 private companies



## Help EERI analyze AERIAL imagery of Haiti?

Dear Colleagues,

A group of members and colleagues are currently participating in a project with ImageCat to analyze high resolution AERIAL imagery of Haiti. This analysis has to be done quickly--see below. People are finding the project quite interesting, so we would like to open up the process to any member who is a structural engineer, scientist, or GIS expert.

ImageCat has acquired high resolution AERIAL imagery of Haiti (better quality than satellite imagery), and they are assisting the World Bank in performing a preliminary damage assessment by analyzing these aerial images. EERI is assisting in this phase, by recruiting volunteers who are willing to take on the analysis of one or more grids before this SUNDAY. This is the second phase of the damage assessment--a phase was conducted last weekend by colleagues in various countries, using satellite imagery. This aerial imagery is of such good quality that now we need analysts who are either structural engineers, scientists or GIS experts to take a look.

Analyzing a grid can take between 10 minutes and 1 hour--some people take another grid after analyzing one; others are just doing the one. The main thing is that once you enter the system, with a log-in, and sign up for a grid, you must complete the analysis.

If you are willing to help with this critical task, please let Marjorie Greene of the EERI staff ([mjgreene@eeri.org](mailto:mjgreene@eeri.org)) know immediately and you will be sent instructions and a log-in and password to get started. As further imagery becomes available, we may put out a second call for assistance next week.

### More About EERI

The Earthquake Engineering Research Institute is a national, nonprofit, technical society of engineers, geoscientists, architects, planners, public officials, and social scientists. EERI members include researchers, practicing professionals, educators, government officials, and building code regulators.

- ▶ EERI call for help
- ▶ Mail forwards
- ▶ Blogs and Groups



# Damage Interpretation Guidelines



**Level 5 - Destruction:** All or most of building structure collapsed. Here: Collapsed/broken roof, walls destroyed (debris surrounding building)








**Level 4 - Very heavy damage:** Part of building structure collapsed, such as part of roof or one or more fallen walls. Wall fallen into street (bright debris)



**Level 3 - Substantial to heavy damage:** Limited damage observed to building, or no damage observed but immediately adjacent to destroyed or very heavily damaged building. Here: Centre building assessed has limited damage (some debris to the left of building), but bright building adjacent (above) severely damaged as seen in collapsed walls (debris to the left of building)



**No visible damage:** Assessed building does not appear to be damaged. Here: Centre building with brown roof seems intact. No debris or collapsed structure is observed. Neighboring buildings do not show damage either, providing contextual information to help decide on the "no damage" state.

Classification of damage to masonry buildings	
	<b>Grade 1: Negligible to slight damage</b> (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.
	<b>Grade 2: Moderate damage</b> (slight structural damage, moderate non-structural damage) Cracks in many walls. Fall of fairly large pieces of plaster. Partial collapse of chimneys.
	<b>Grade 3: Substantial to heavy damage</b> (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).
	<b>Grade 4: Very heavy damage</b> (heavy structural damage, very heavy non-structural damage) Serious failure of walls; partial structural failure of roofs and floors.
	<b>Grade 5: Destruction</b> (very heavy structural damage) Total or near total collapse.

## EMS-98 damage scale



**18639**

5,90;roof displaced

7/12/2010

10



2010



2010

# The Situation Room at the World Bank, Washington D.C.

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Photo courtesy of the World Bank

# Novelty of 21st century response



- ▶ Clarity of Data
- ▶ Rapidity of Damage Assessment
- ▶ Actionable results for Rapid decision making
- ▶ Information Dissemination Networks and Portals



Select date

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Rue Pavée

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7/2/2010

2009

Google

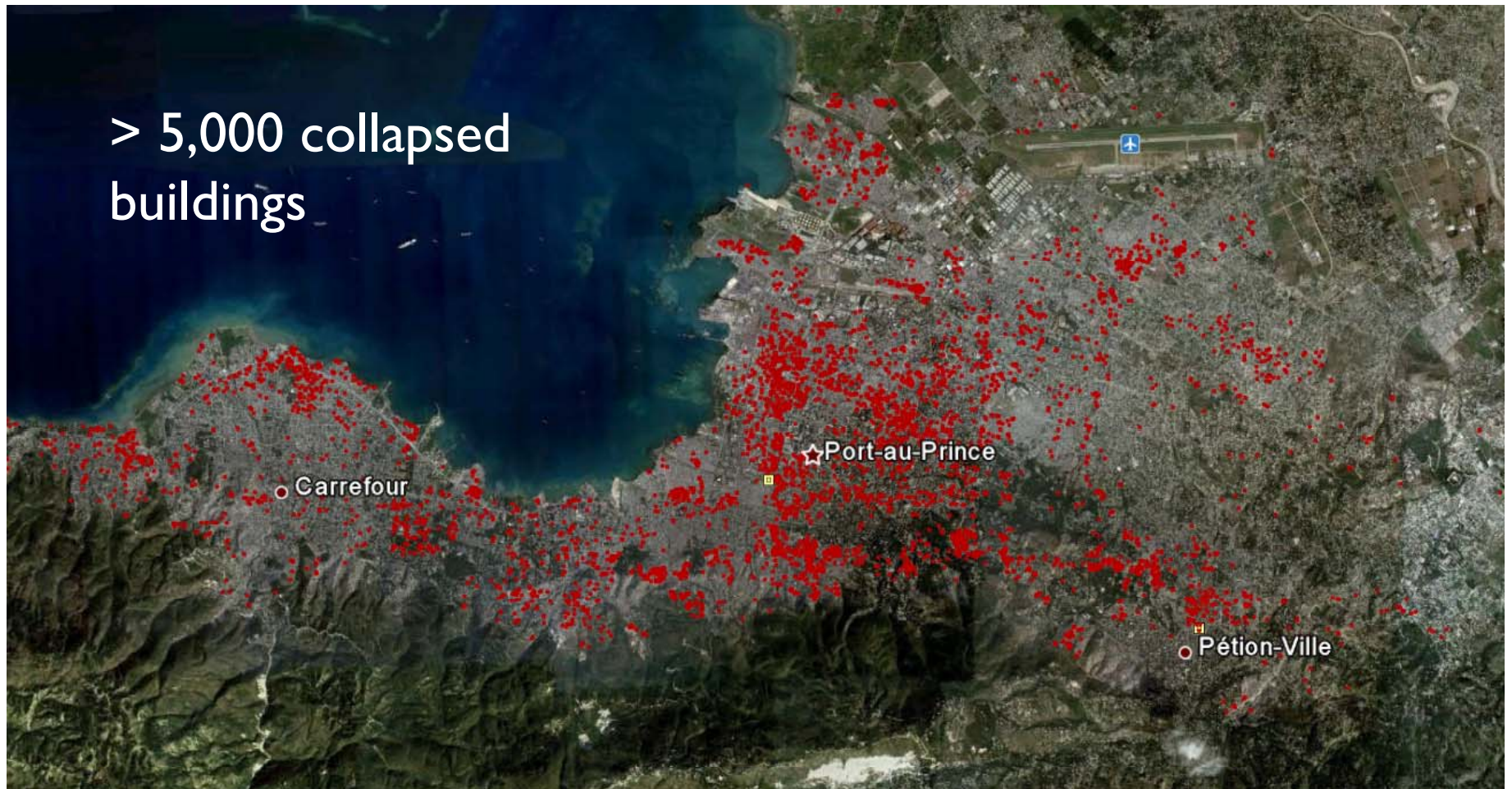
Imagery Date: Jan 25, 2010

18°32'59.44" N 72°20'39.68" W elev 0 ft

Eye alt 505 ft

# Phase 1 results

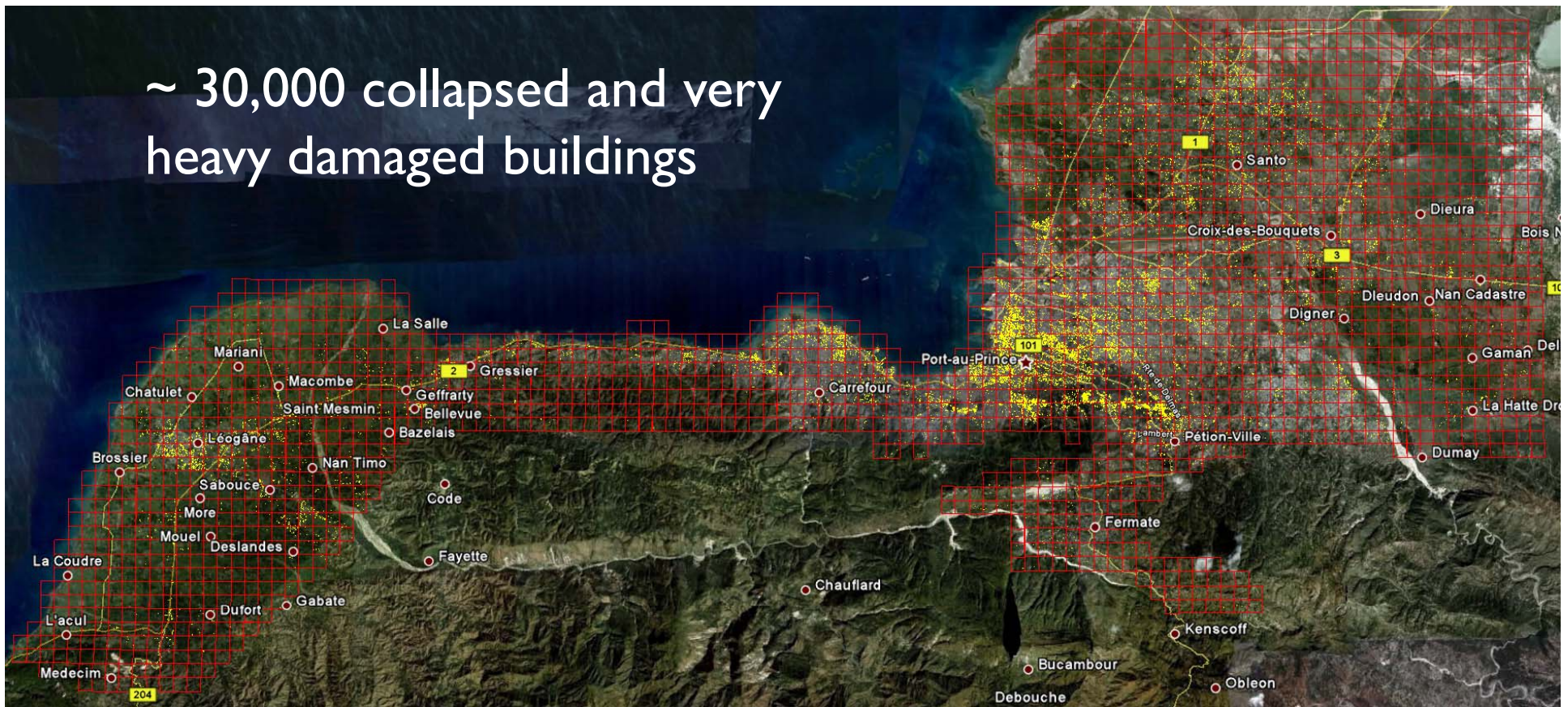
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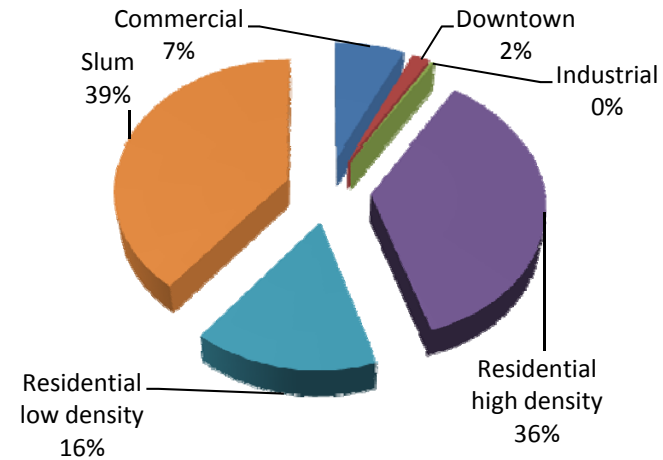
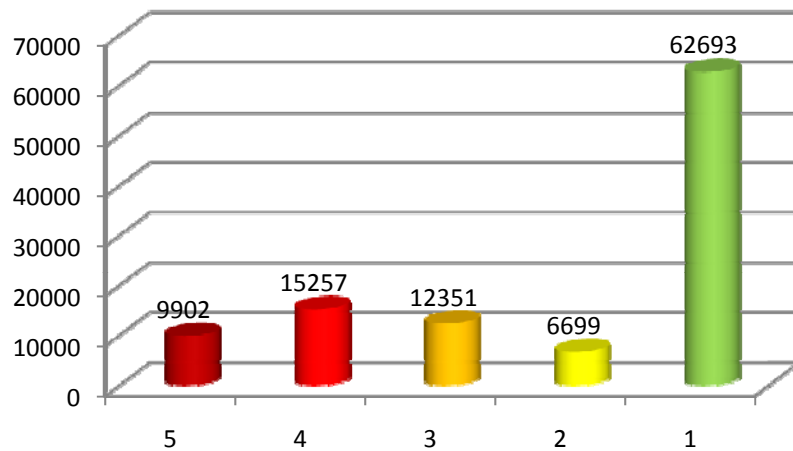
# Phase 2 Results

~ 30,000 collapsed and very heavy damaged buildings



# World Bank – UNOSAT – JRC Joint Damage Assessment

Number of Damaged Buildings per EMS-98 Class



	5	4	3	2	1
<b>PORT-AU-PRINCE</b>	<b>1128855</b>	<b>1678626</b>	<b>1455252</b>	<b>915331</b>	<b>6848650</b>
Commercial	241488	353964	245076	256776	70044
Downtown	78249	84495	66971	70094	19085
Industrial	7091	16993	9901	10303	2810
Residential high density	400698	577714	566345	360377	3192630
Residential low density	157440	227140	302088	164820	1895348
Shanty	243889	418321	264871	52962	1668733
<b>Grand Total</b>	<b>1128855</b>	<b>1678627</b>	<b>1455252</b>	<b>915332</b>	<b>6848650</b>
Cost in US\$ per m <sup>2</sup>	500	500	300	100	40
<b>Total cost (MUS\$)</b>	<b>564.4275</b>	<b>839.3135</b>	<b>436.5756</b>	<b>91.5332</b>	<b>273.946</b>

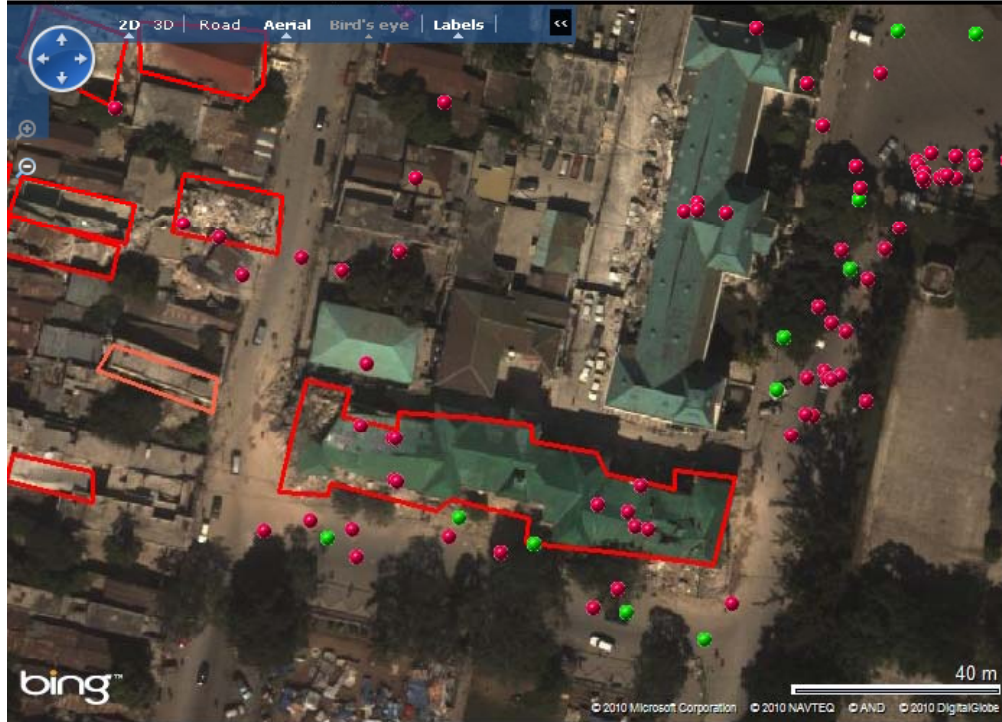
## Example of Damage Figures for Port au Prince:

- Number of buildings per class
- Damages per land use class
- Floor area per land use type and damage class allowing a monetary estimation of damages (approx. 2.2 billion \$US for Port-au-Prince)

# VDV *Virtual Disaster Viewer*

Viewing event: 2010 Haiti Earthquake (change)

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Imagery | Other Layers | Field Data | GEO-CAN Community | Comments

Photo

Show Video Stills  
 Show Photos  
 (Click on ● to preview photo)

(download complete KML photo layer for this event)

(most recent photos)  
 (most recent photo comments)  
 (search photo comments)



Photo courtesy of EERI. © 2010 EERI  
[View Comments](#)



Note: Photo locations not verified. Analysis results are preliminary.



[www.virtualdisasterviewer.com](http://www.virtualdisasterviewer.com)

# The Future

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- ▶ Crowd-sourcing is the way of the future for rapid and distributed damage assessment
- ▶ GEO-CAN community is ready (and willing) to perform again - new participants still applying to the community
- ▶ A formal structure for participating- formalizing GEO-CAN initiative
- ▶ Pre-event training for remote sensing damage assessment
- ▶ Developing protocols for addressing other natural hazards