Evaluation of Tsunami Damage in the Eastern Part of Sri Lanka due to the 2004 Sumatra Earthquake using High-Resolution Satellite Images

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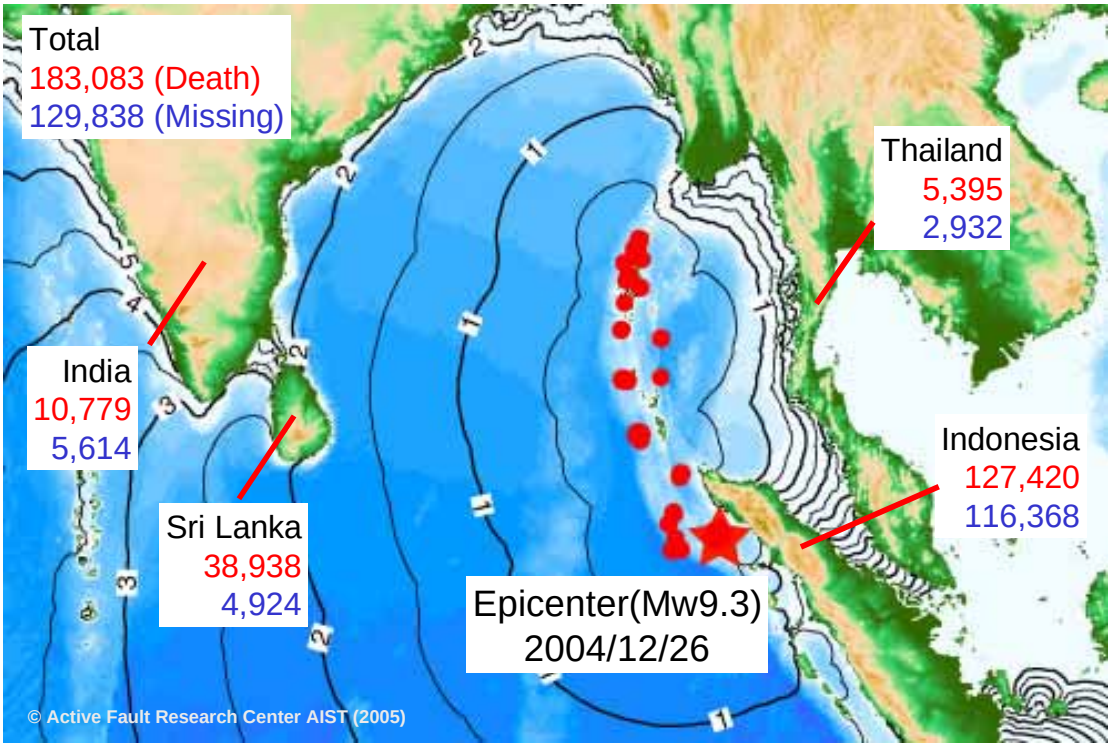
Background and Objectives

- Need to grasp damage distribution quickly after a disaster for emergency response
- Use of high-resolution satellite images for post-event damage assessment
- Tsunami generated by the 26 Dec. 2004 Sumatra earthquake (Mw9.3)

Evaluation of tsunami damage in Sri Lanka using pre- and post-event IKONOS images

Casualties in the 2004 Sumatra Earthquake



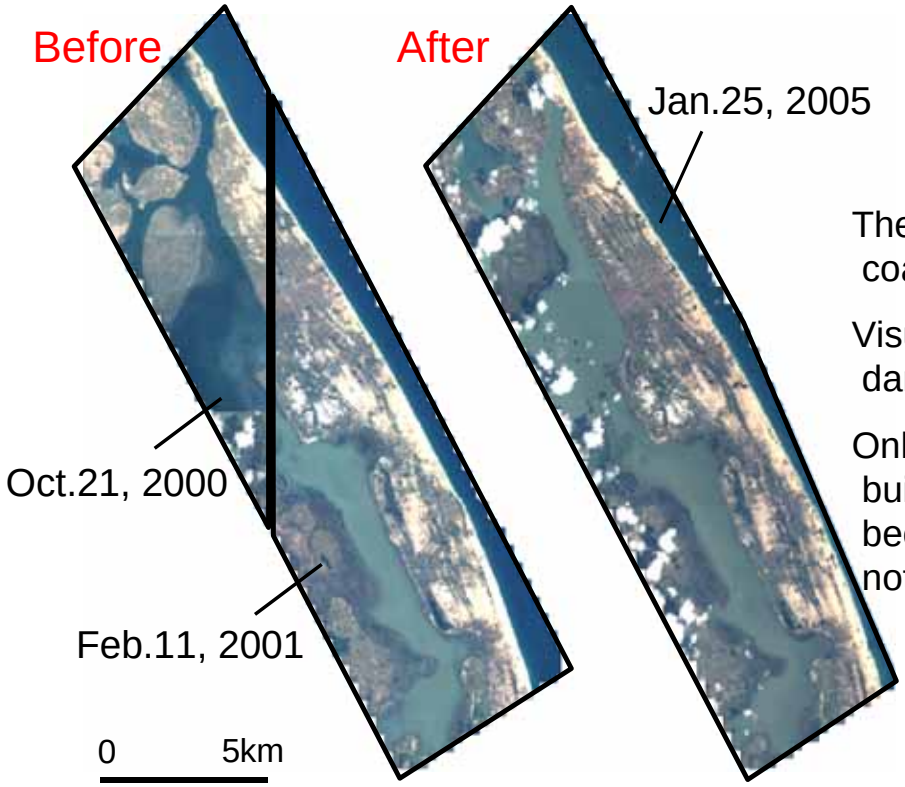
Severe damage is observed also in Sri Lanka

Tsunami Damage in Sri Lanka

District	Deaths	Missing	Damaged Houses	
			Completely	Partially
Jaffna	2,640	540	6,084	1,114
Trincomalee	1,078	337	5,974	10,394
Batticaloa	2,840	1,033	15,939	5,665
Ampara	10,436	873	29,199	—
Hambantota	4,500	963	2,303	1,744
Matara	1,342	613	2,362	5,659
Galle	4,218	554	5,525	5,966
Colombo	79	12	3,398	2,210

Eastern and southern provinces show severer damage than western one. Batticaloa is one of the districts that severe damage is observed.

IKONOS Images in Batticaloa



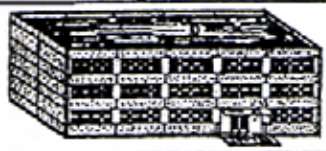
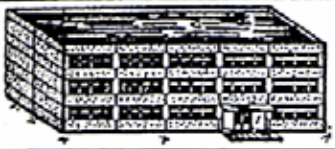
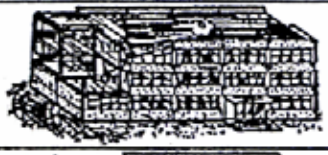
Resolution:1m
Area size:124km^2
Type:Pan Sharpen

The image cover 1/10 of the coastal line in Batticaloa.

Visual inspection of building damage is applied.

Only severely damaged buildings are identified because the resolution is not enough fine.

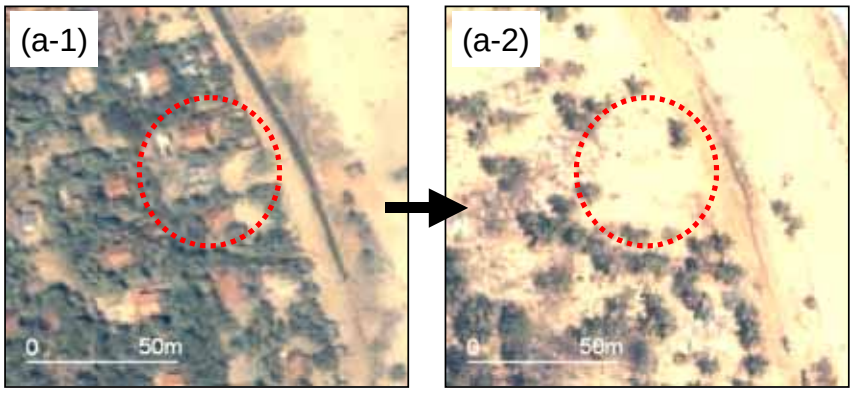
European Macroseismic Scale (EMS)

Damage Pattern	Damage Level
	**Grade 1**: Negligible to slight damage (no structural damage, slight non-structural damage)
	**Grade 2**: Moderate damage (slight structural damage, moderate non-structural damage)
	**Grade 3**: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)
	**Grade 4**: Very heavy damage (heavy structural damage, very heavy non-structural damage)
	**Grade 5**: Destruction (very heavy structural damage)

Visual Detection of Building Damage 1/2

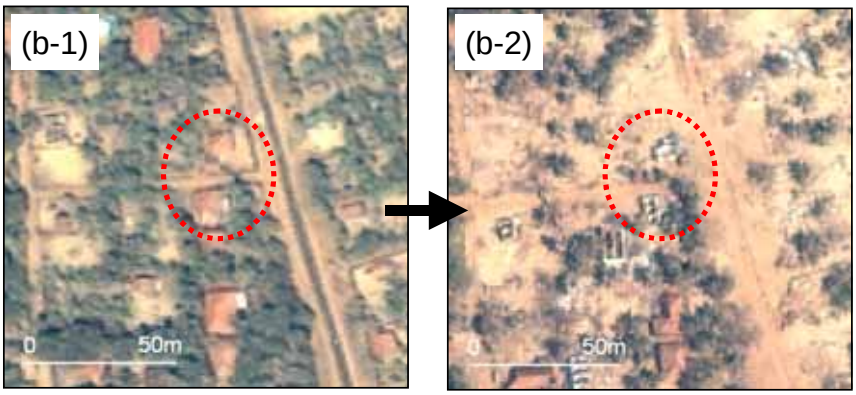
Before

After



Buildings and vegetation disappear in post-event image.

Washed away building



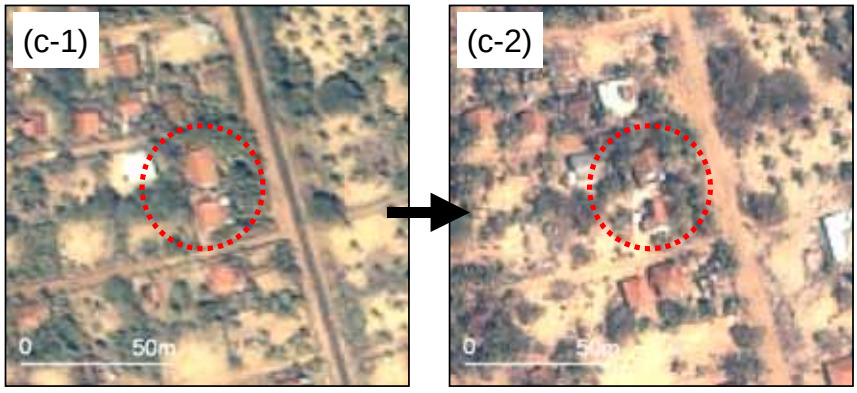
Roof and wall are destroyed.
Bottom of buildings is exposed.

Totally collapsed building (Grade 5)

Visual Detection of Building Damage 2/2

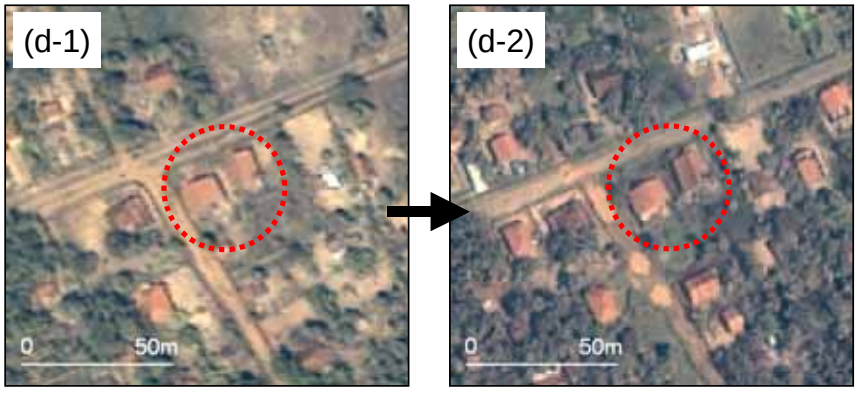
Before

After



Part of building is failed.
Many debris is observed.

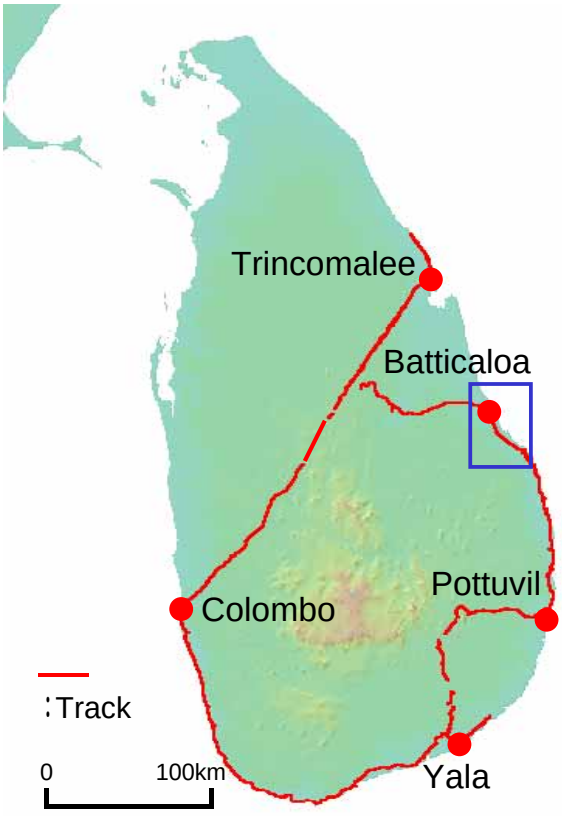
Partially collapsed building (Grade 4)



Significant difference is not identified.

No or slightly damaged building (Grade 1)

Field Survey of Sri Lanka in March, 2005



Date: 11-18 March, 2005

Purpose of survey:

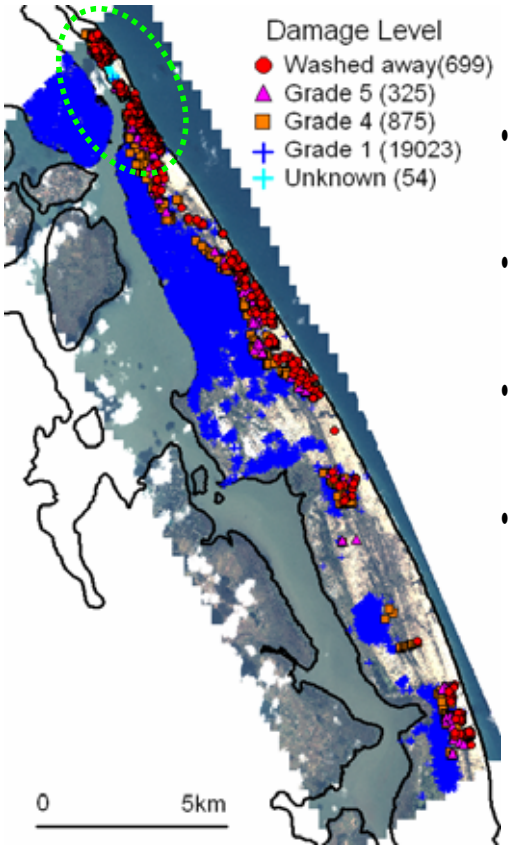
- Investigation of tsunami damage
- Measurement of tsunami height
- GPS survey for inundation area
- Interview of arrival time of tsunami

Comparison with Actual Damage

Washed away building

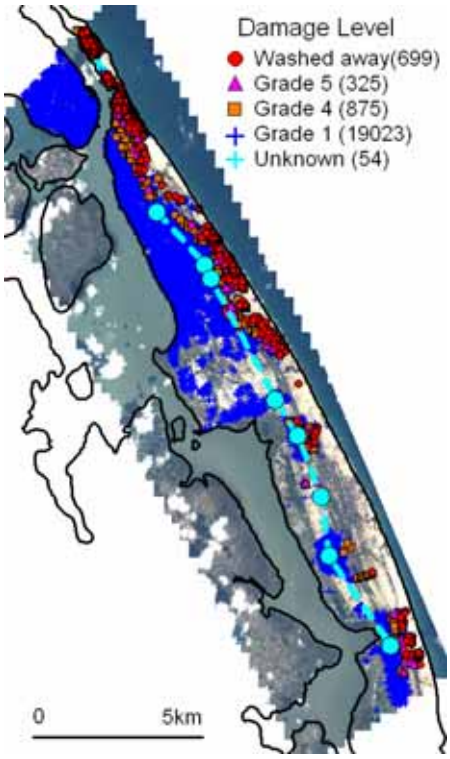
Totally collapsed building

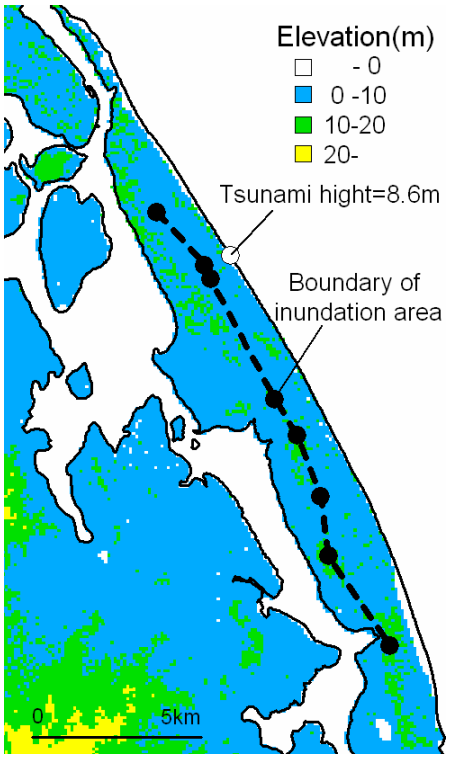
Distribution of Building Damage



- About 10% of buildings are classified into severely damaged buildings.
- Damaged buildings are concentrated in the eastern coastal line.
- The damage is distributed in inland area within 1km distance from coast.
- Severest damage is observed in northern area in which width of land is narrow (dotted circle)

Comparison with Inundation Area





Damaged buildings are distributed in inundation area.

Concluding Remarks

- Visual detection of building damage is applied to pre- and post-event images in Sri Lanka that were severely damaged due to the 2004 Sumatra Eq.
- Buildings are classified according to the damage level. Classification shows good agreement with the actual damage.
- Damaged buildings are distributed in the inundation area that are investigated using GPS.