

Development of Building Inventory Data in Lima

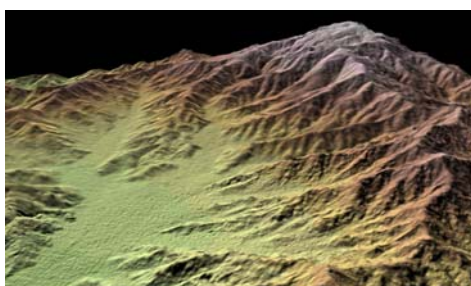


Group 4

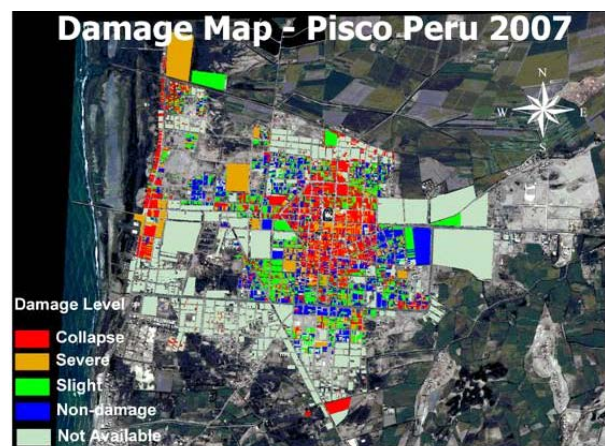
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G4: Geo-Spatial Database and Damage Assessment

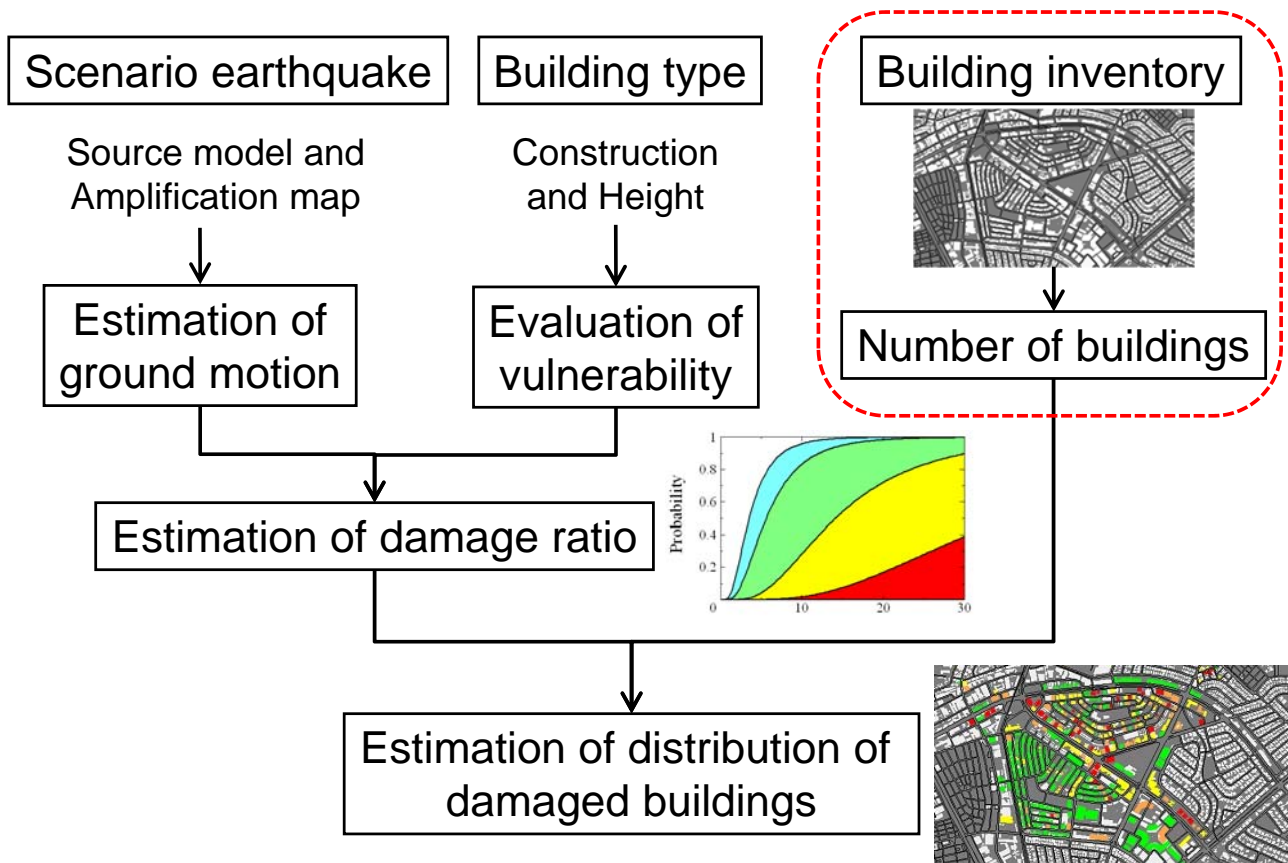
- Development of Geo-Spatial Database
- Damage Detection using Satellite Images
- Damage Assessment for Scenario Earthquakes



2.5m DEM by
ALOS/PRISM



Damage Assessment for Scenario Earthquake

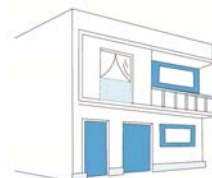


Existing Census Data in Lima

Census 2007 Data in Lima

The census GIS data contains number of households for each building type in every city block of Lima city.

It does **NOT** contain number of buildings and building height information that are necessary for damage assessment.



Individual house



Apartment house



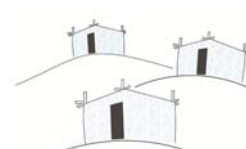
"Quinta" house



Tenement house



Cabin house



Temporary house



Non-residential building

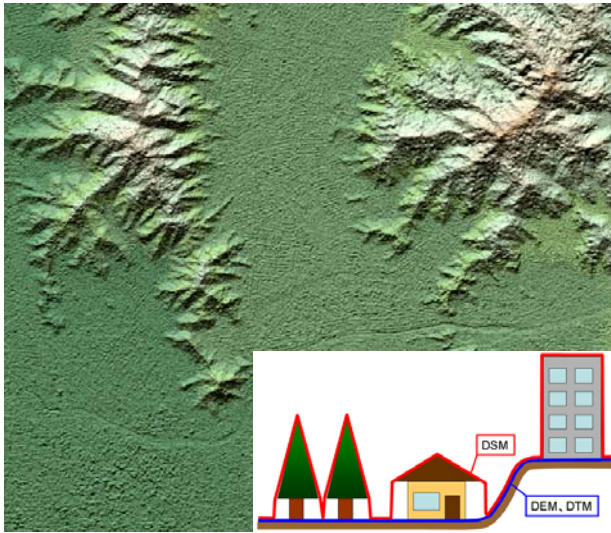


Others (Vehicle etc.)

Ancillary Remote Sensing Data

Number of building and building height are estimated by using ancillary remote sensing data.

Digital Surface Model (DSM)



Created from ALOS/PRISM images
Spatial resolution = 2.5m

For estimation of building height

High-Resolution Satellite Image



WorldView-2 satellite image
Spatial resolution = 0.5m

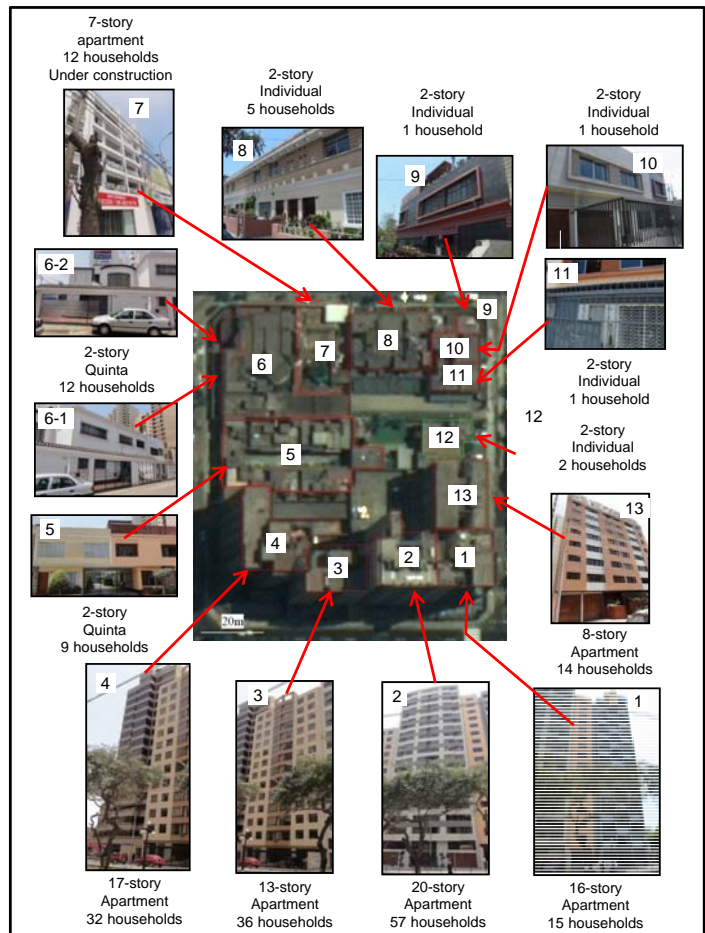
For estimation of number of building and building height

Field Survey for Building Inventory



We conducted field survey in Lima on 19-28 Sep, 2011 to collect building information (number of buildings, households, building use and building height) for several residential areas.

Satellite image with ground photos and surveyed building information



Comparison of Census Data and Field Survey

	Individual house			Apartment house			Quinta house		
	Census	Field survey		Census	Field survey		Census	Field survey	
	House holds	House holds	Num. buildings	House holds	House holds	Num. buildings	House holds	House holds	Num. buildings
Miraflores-1	32	10	5	141	154	5	-	21	2
Miraflores-2	17	10	10	121	140	8	-	-	-
Miraflores-3	15	14	10	139	152	1	6	6	1
San Borja	19	18	13	32	49	8	-	-	-
La Perla-1	76	84	52	31	27	5	-	-	-
La Perla-2	38	34	26	4	6	1	-	-	-
Callao	32	36	34	14	16	3	8	10-12	1

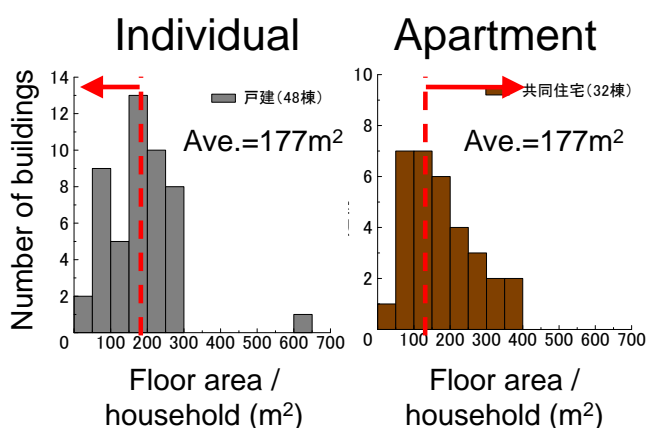
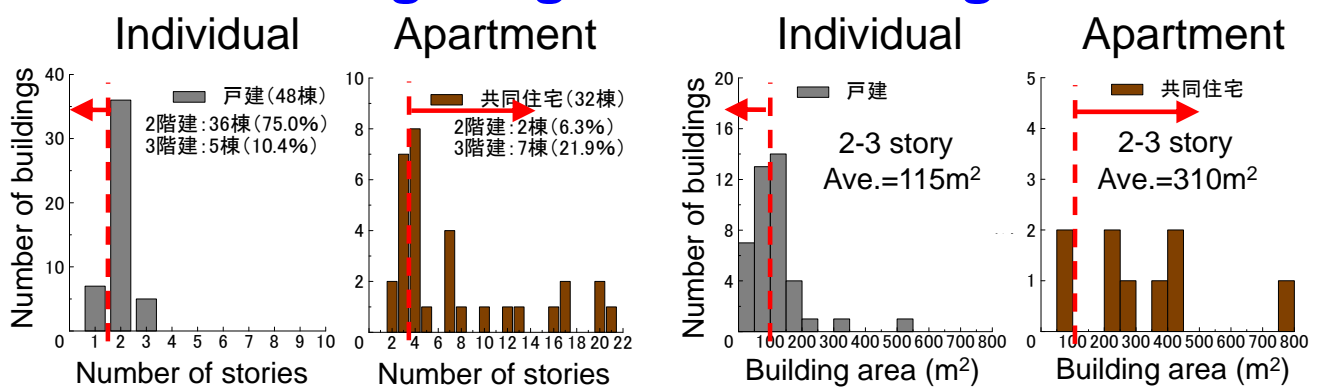
Comparable number of households between census data and field survey

Individual house : 1 households \doteq 1 building

Quinta house : 8 households \doteq 1 building

Apartment house : Number of households / building depends on **size** and **height** of building

Building Height and Building Size



Number of stories

1-story = Individual

Over 4-story = Apartment

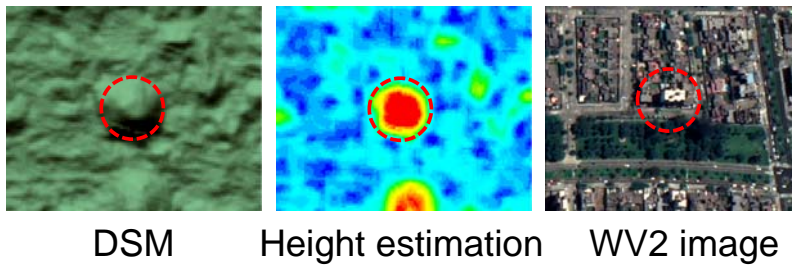
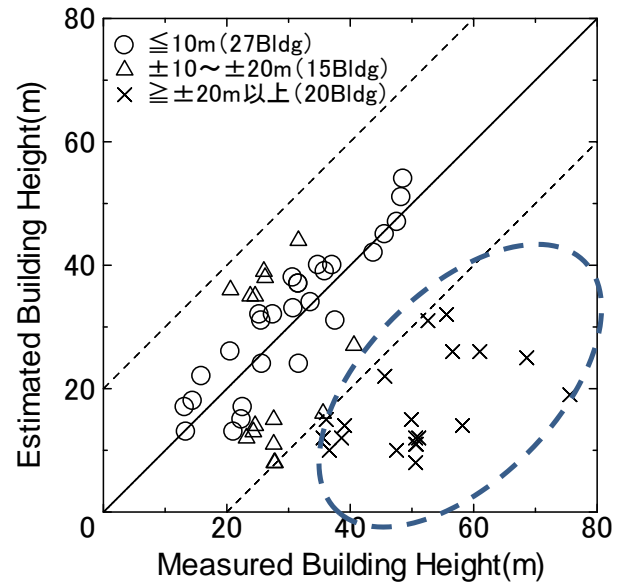
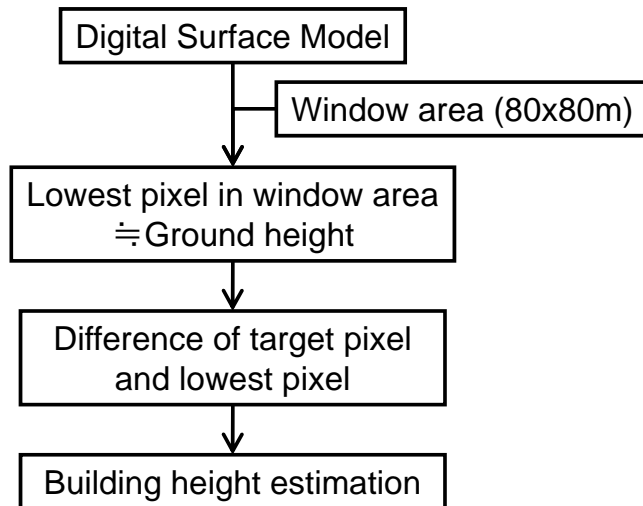
For 2-3 story building

Building area < 100m² = Individual

Building area > 100m² = Apartment

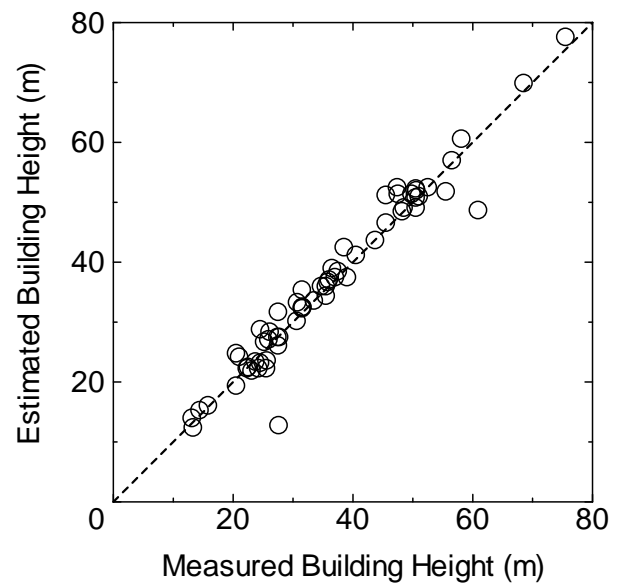
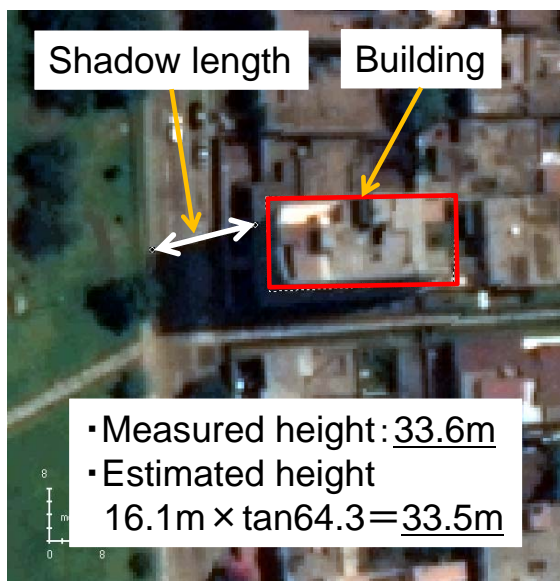
Number of households can be calculated by floor area/household of 180m².

Building Height Estimation from DSM



It is difficult to accurately estimate building height from analysis of 2.5m-resolution DSM.

Building Height Estimation from Satellite Image



Building height is estimated from shadow length in high-resolution satellite image.

The building heights are more accurately estimated.

Estimation of Number of Buildings

For Individual house and Quinta house

Estimated from relation between households and buildings

- Individual : No. of building = No. of household
- Quinta : No. of building = No. of household / 8

For mid- and high-rise apartment house

No. of building, height and building area are detected from high-resolution satellite image

Floor area is calculated from height and building area

No. of households is estimated from

floor area / household of 180m²

For low-rise apartment house

No. of household for low-rise apartment house

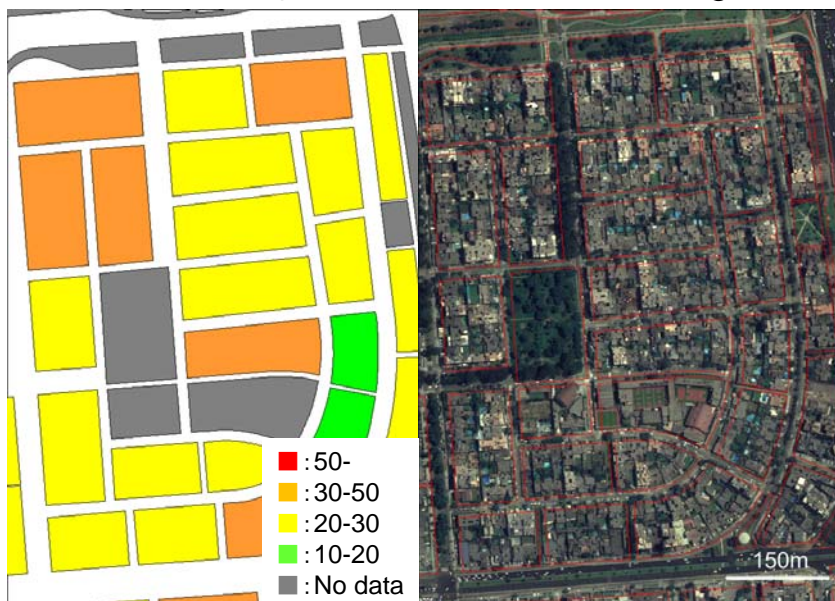
= Census data (apartment) - households of high-rise house

No. of building = No. of households / 4

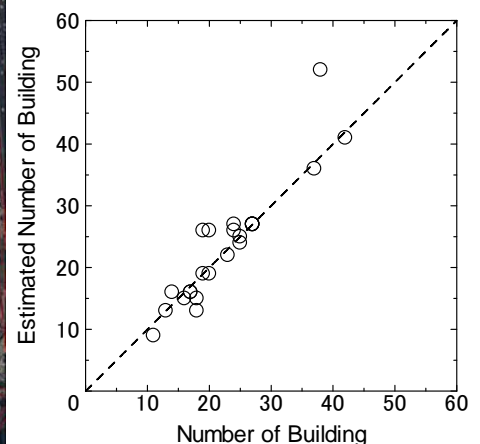
Validation of Estimation

Estimated number
of buildings

High-resolution
satellite image



Comparison of estimation
and visual interpretation



Residential area in San Borja

Number of buildings are accurately estimated by the proposed procedure

Concluding Remarks and Future Works

- A procedure to estimate number of buildings and building height for mid- and high-rise buildings is developed based on the existing census data and high-resolution satellite image
- Number of mid- and high-rise buildings and their heights are manually detected from satellite image.
- The estimated number of buildings are validated by comparing with the visual interpretation.



The proposed procedure is only for residential buildings.
We will collect building footprint data (cadastral data) from Municipalities of Lima to complete inventory data

Thank you for your attention!