

# 1<sup>st</sup> Joint Coordinating Committee

## Enhancement of Earthquake and Tsunami Disaster Mitigation Technology in Peru

### G4: Damage Assessment

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### Project Flow-chart

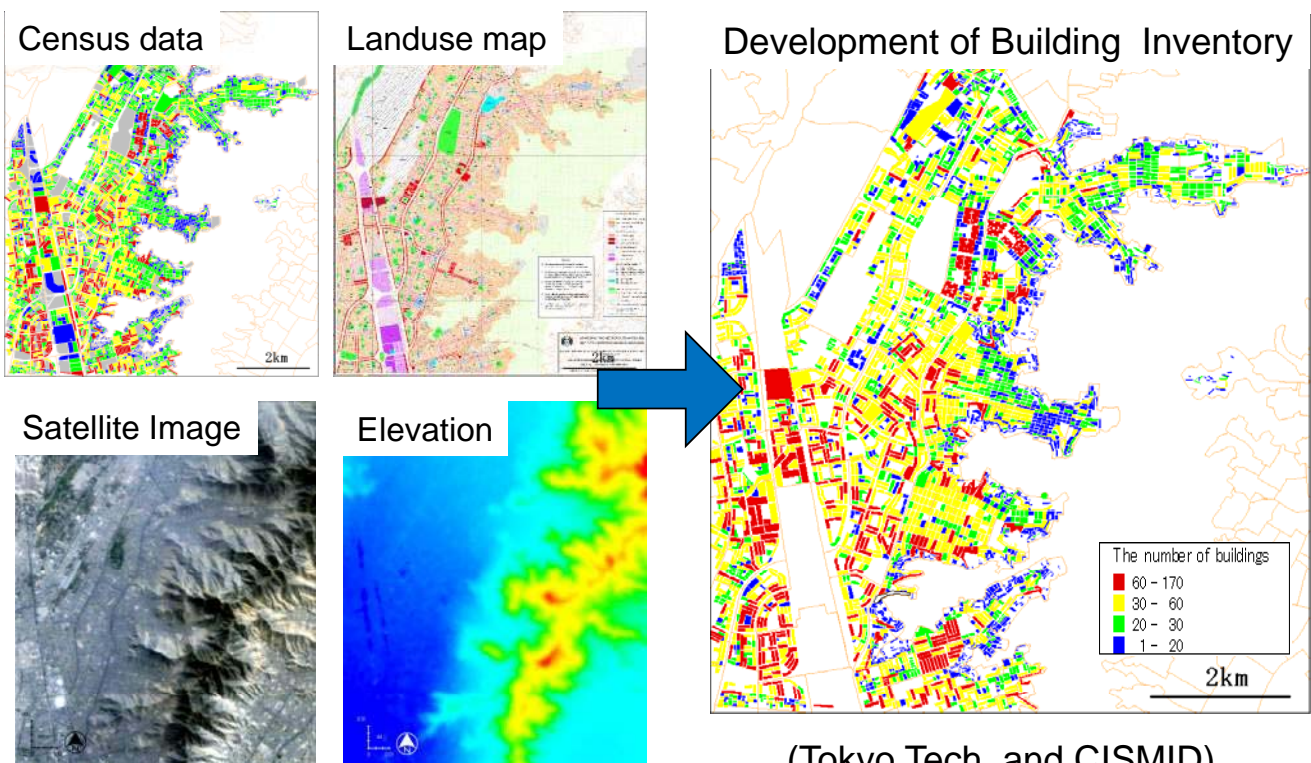
Research Topic (Organization)	Period (2010-2014)					
	2009 <small>(10 Months)</small>	2010	2011	2012	2013	2014 <small>(12Months)</small>
<b>G1: Seismic Motion &amp; Geotechnical</b> 【 Chiba, Tokyo Tech, BRI, NIED, CISMID, IGP】 1) Source Modeling and Seismic Motion 2) Site Response & Microzonatio 3) Slope Failure Assessment		← Source Modeling →	← Simulation of Strong Motion →			
		← EQ and MT Measurement →	← Microzonation →			
	← Field Survey →	← Seismic Response →	← Hazard Map →			
<b>G2: Tsunami</b> 【Tohoku, BRI, Tsukuba, TEPCO DHN, CISMID】 1) Tsunami Propagation and Impacts 2) Tsunami Hazard Mapping 3) Tsunami Damage Mitigation Technology		← Tsunami Simulation →	← Inundation and Impact →			
	← Data Collection →	← Damage Assessment Method →	← Tsunami Damage Analysis →			
	← Historical Tsunami Data →	← Tsunami Damage Mitigation technology →				
<b>G3: Buildings</b> 【BRI, Nagoya, Yokohama National, Akita Pref., CISMID】 1) Seismic Tests Database 2) Diagnosis and Retrofit 3) Retrofit of Historical Buildings		← Literature Survey, Tests →	← Database Development →			
	← Diagnosis Method →	← Retrofit Technology, Validation Tests →	← Guideline →			
	← Survey, Risk Assessment →	← Retrofit Technology →	← Guideline →			
<b>G4: Damage Assessment</b> 【Tokyo Tech, Chiba, AIST, Tsukuba, CISMID】 1) Geo-spatial Database 2) Damage Detection using Remote Sensing 3) Damage Assessment for Scenario EQ	← Data Collection →	← Geospatial Data →	← Database Development →			
	← Data Collection →	← Methodology →	← Damage Detection →			
	← Damage Assessment Method →	← Assessment, Risk Map →				
<b>G5: Disaster Mitigation Plan and Project Management</b> 【 Chiba, Tohoku, BRI, Tokyo Tech, Ritsumeikan, INDECI, CISMID】 1) Project Management 2) Disaster Mitigation Planning	← WS▼ →	← WS▼ →	← WS▼ →	← WS▼ →	← WS▼ →	
	← Workshop Organization →	← Mitigation Planning →	← Dissemination, Education →			

# Equipment List

Year	Items	Quantity	Price
2010	Workstation for remote sensing data analysis (Desktop)	2	\$5,518.46
2010	Software for remote sensing data analysis (ENV+IDL)	3licences	\$5,928.75
2010	Statistic(Census) Data of Lima City	1set	S./27,090.00
2010	High Resolution Satellite Image Data	6sets	¥6,110,715
2011	GPS Device	1	¥1,709,400
2011	High Resolution Satellite Image Data	1set	¥1,453,705
2011	Plotter (A0)	1	\$5,860.00
2011	Laser Printer (A3)	1	\$5,416.20
2011	Handy GPS with Camera	2	\$2,000.00

- Basic Geo-spatial data  
Census data and Satellite image data
- Analysis of Geo-spatial data  
Workstation, Software, Plotter and Printer
- Equipment for field survey  
GPS device and Handy GPS, Spectrometer

## Progress Report Geo-Spatial Database

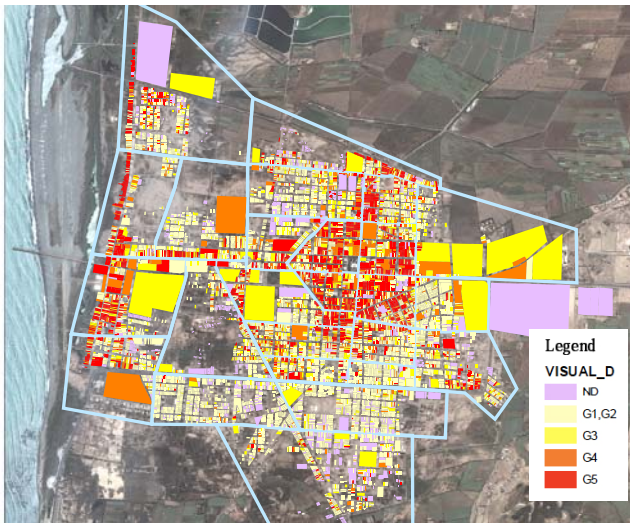


(Tokyo Tech. and CISMID)

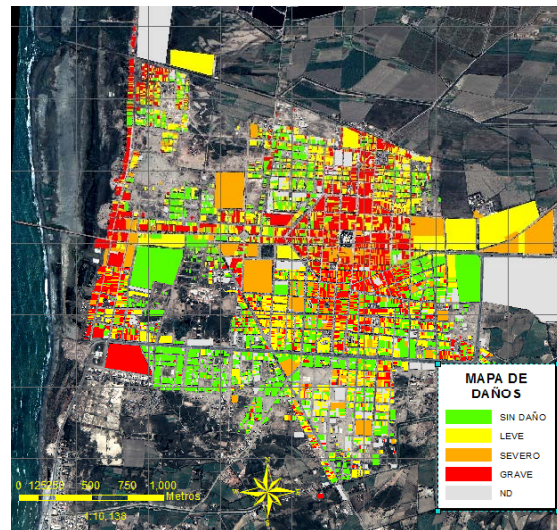
# Progress Report

## Damage Detection using Remote Sensing

The 2007 Pisco, Peru Earthquake



Visual Interpretation of Satellite Images



Building damage by Field Survey



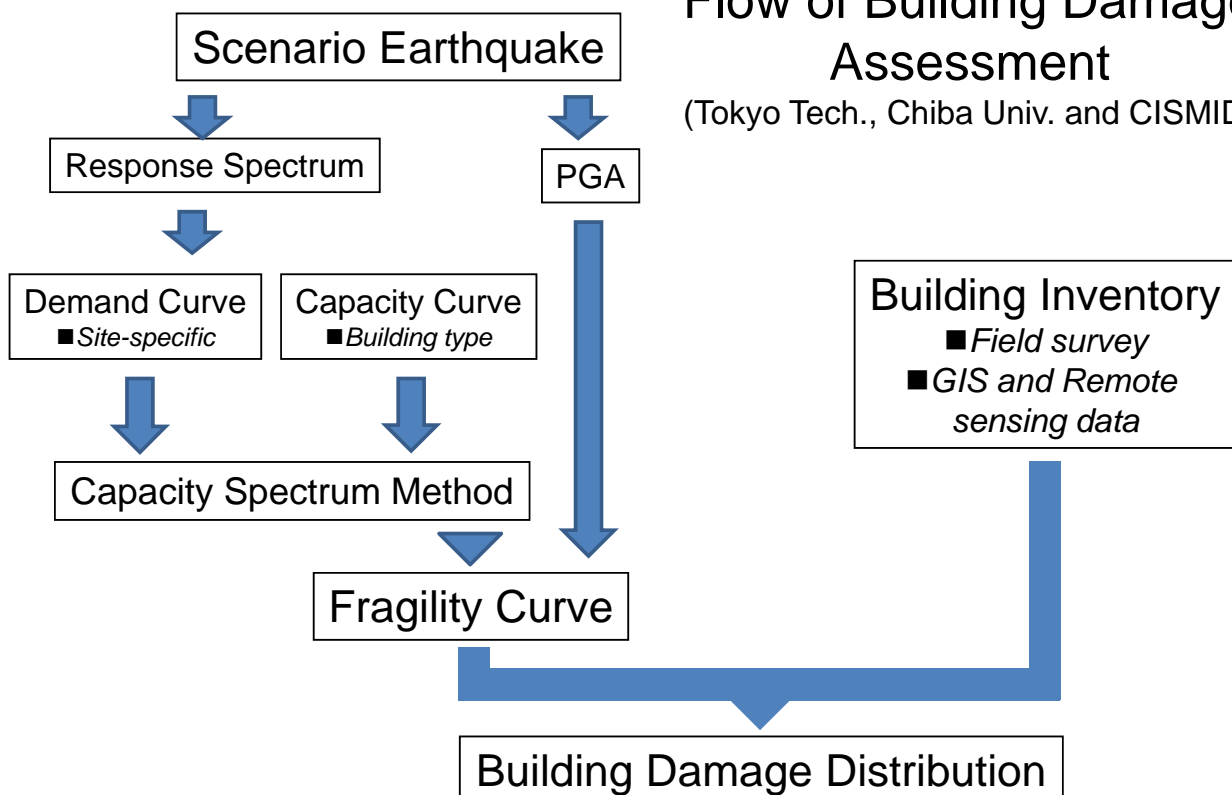
Validation

(Chiba Univ. and CISMID)

## Damage Assessment of Scenario Earthquake

Flow of Building Damage Assessment

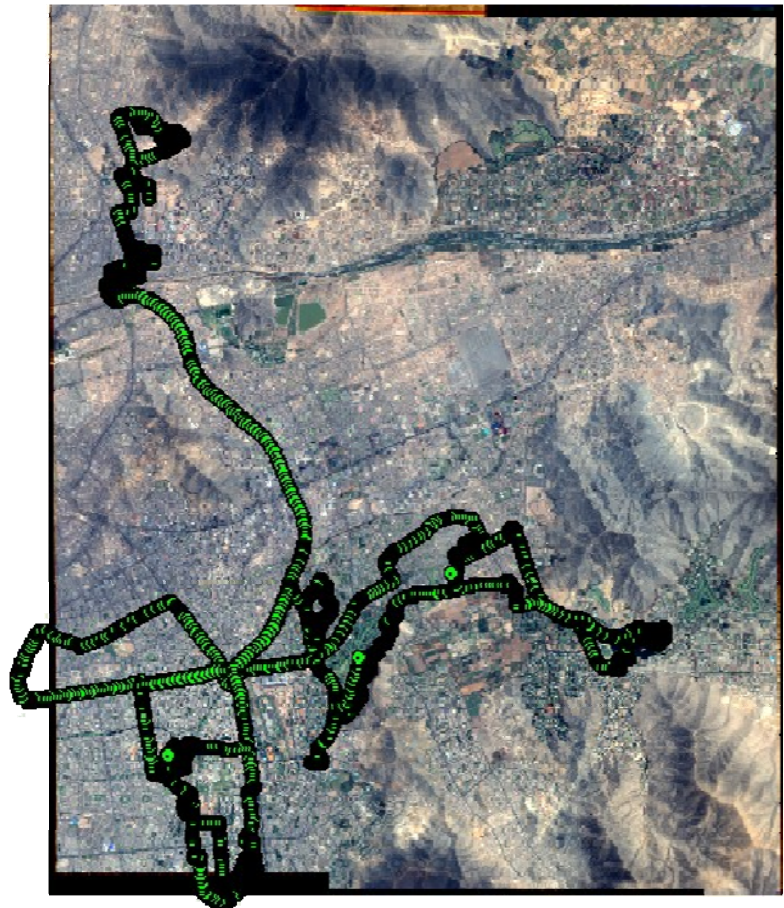
(Tokyo Tech., Chiba Univ. and CISMID)



# Image Sharpening



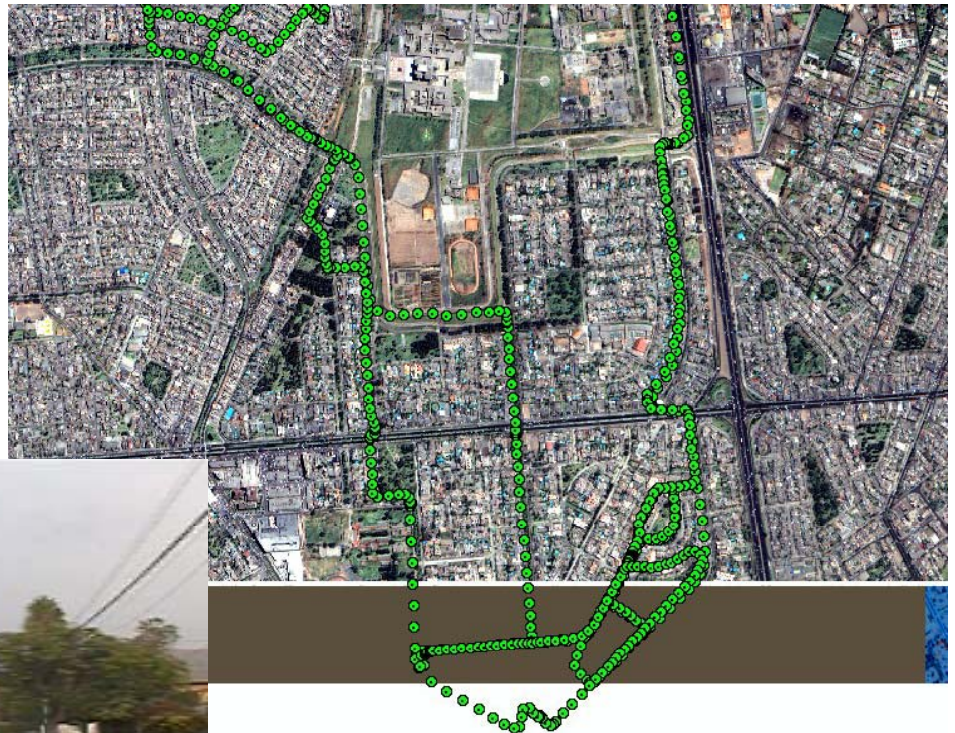
# Phase 1: Identification



# Phase 2: Video



# Phase 3: Video



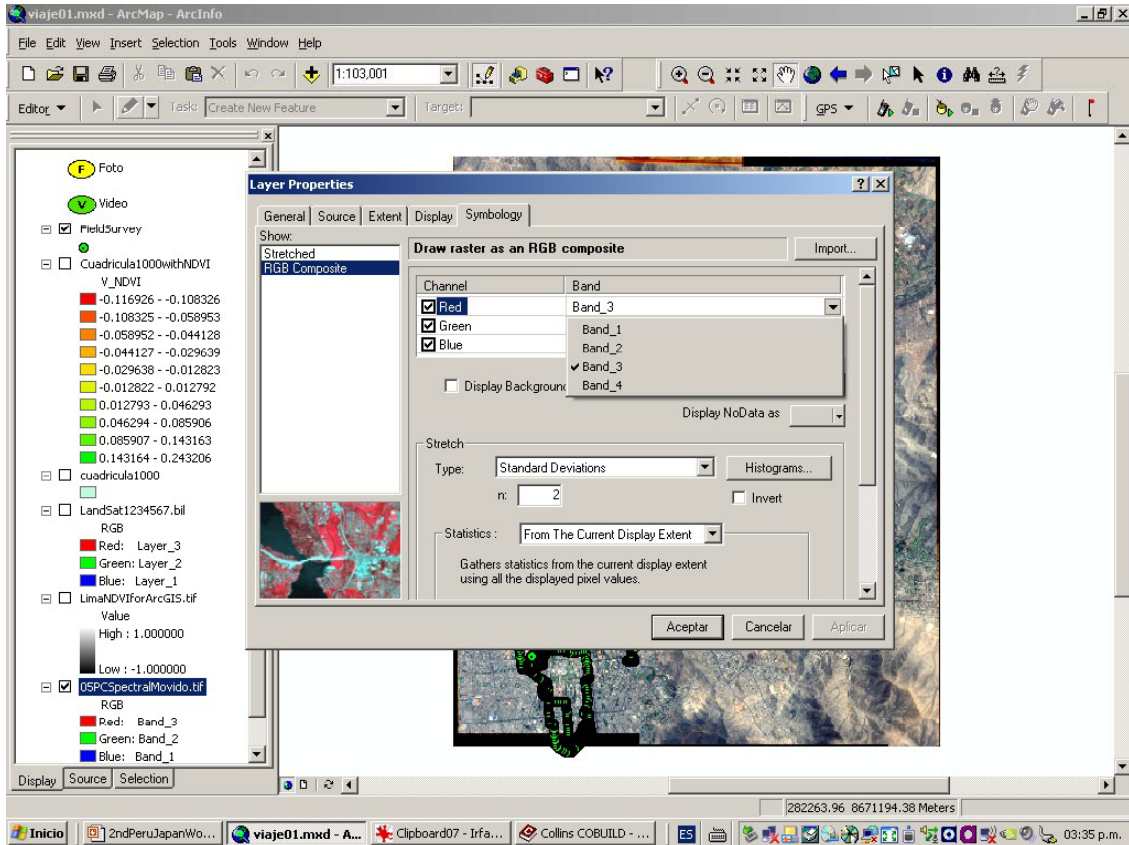
Phase 4  
Video



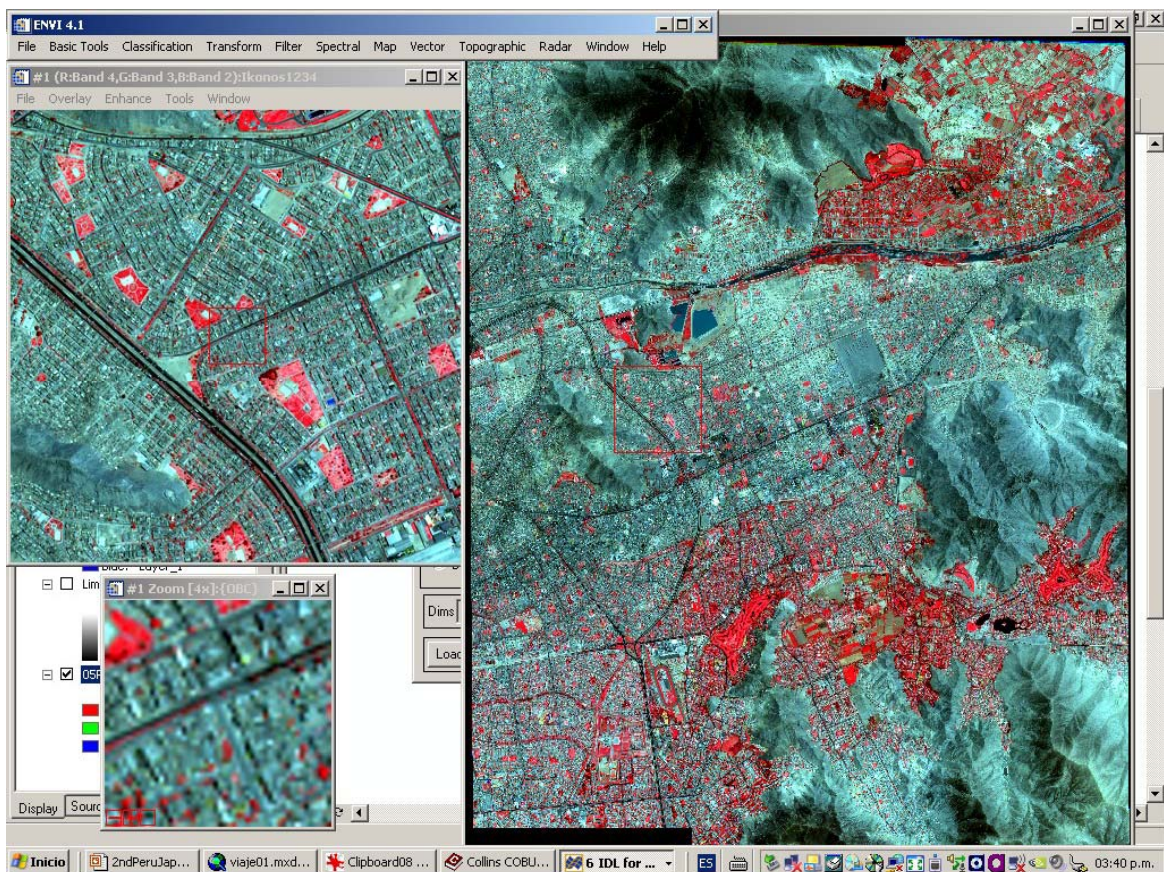
Phase  
Video



# Spectral Analysis



# Pseudo-Color Infrared Image

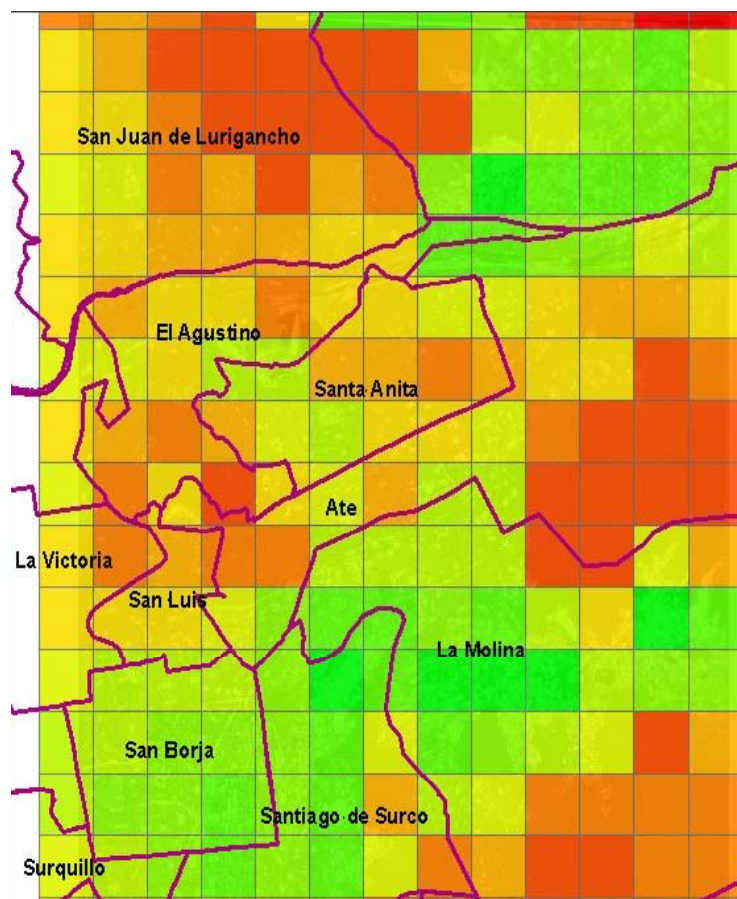


# Vegetation Index

$$NDVI_{(i,j)} = \frac{NIR_{(i,j)} - R_{(i,j)}}{NIR_{(i,j)} + R_{(i,j)}}$$

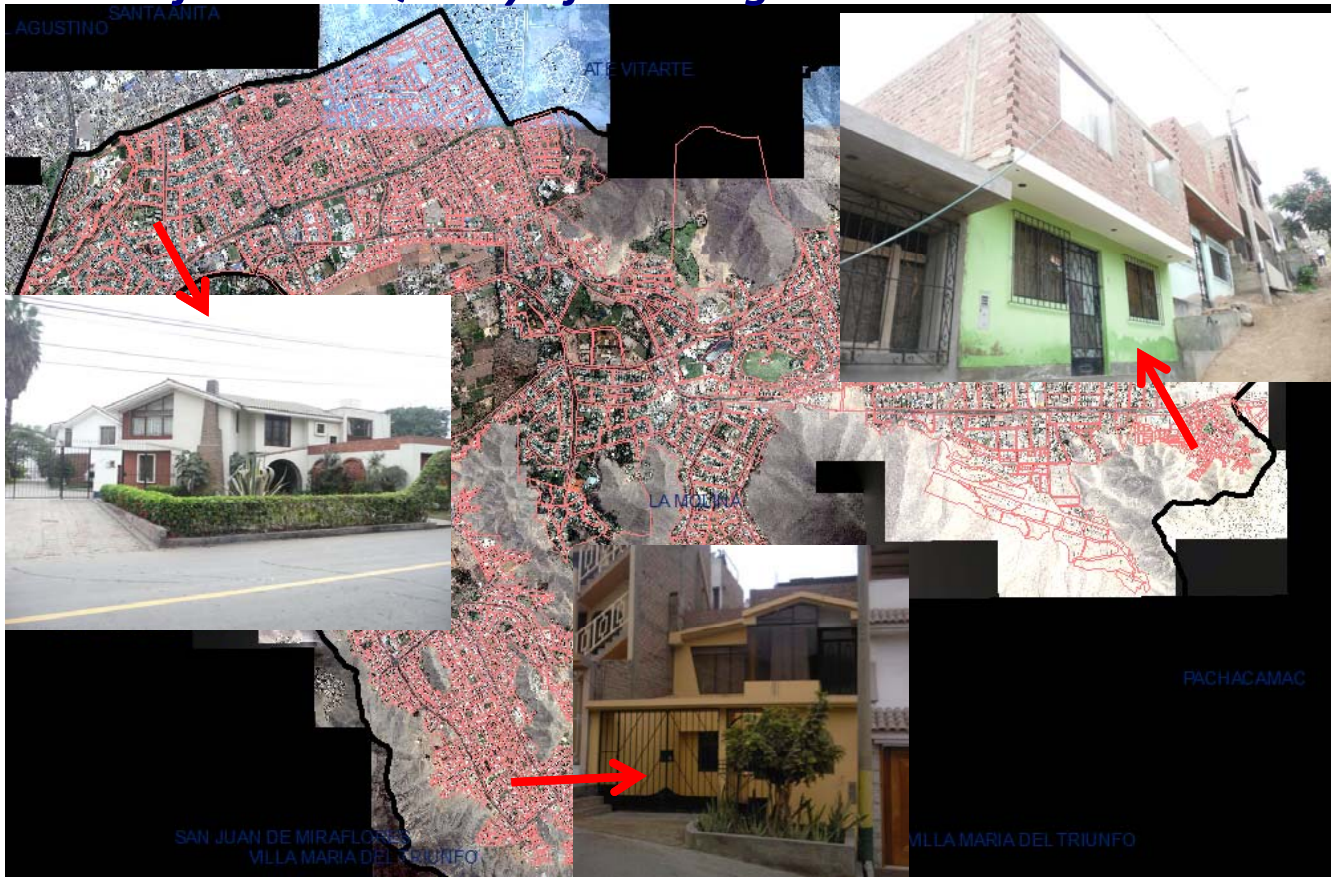


# Cluster Analysis



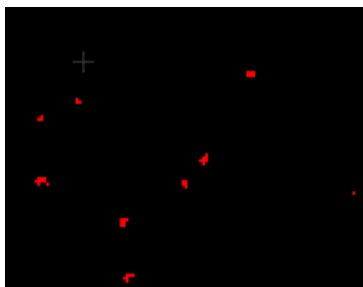


# Same Material but Different Social Class Defines the Quality of Buildings – La Molina District



## Results

Classification Method: Spectral Angle Mapper Classification

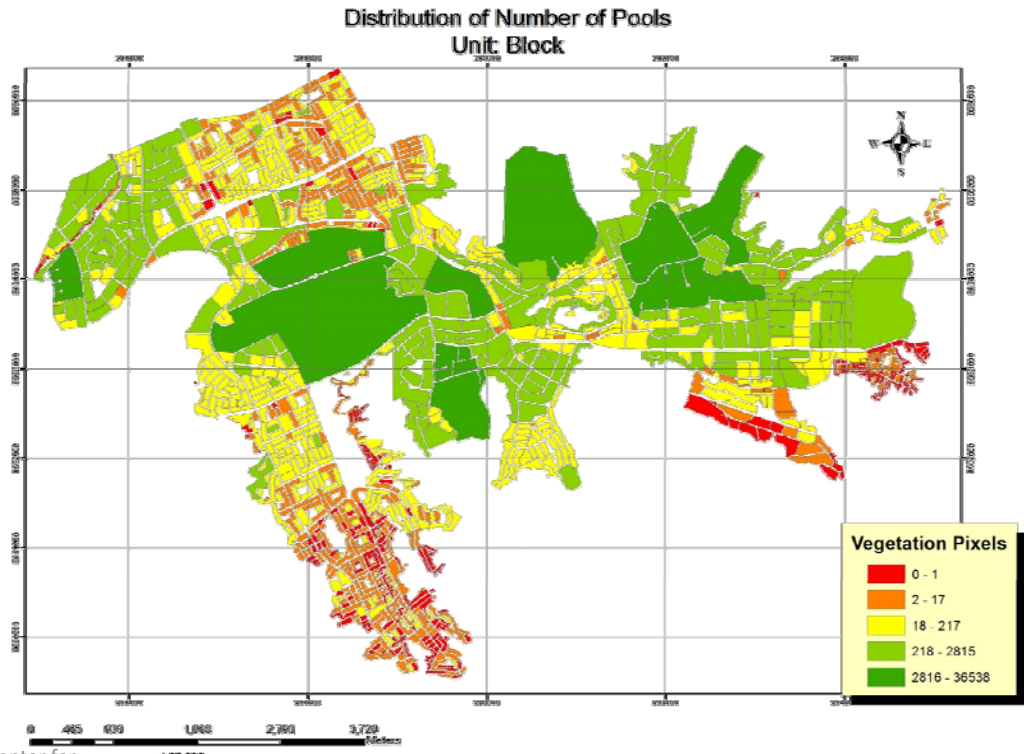


Good agreement  
between classification  
and real Image data



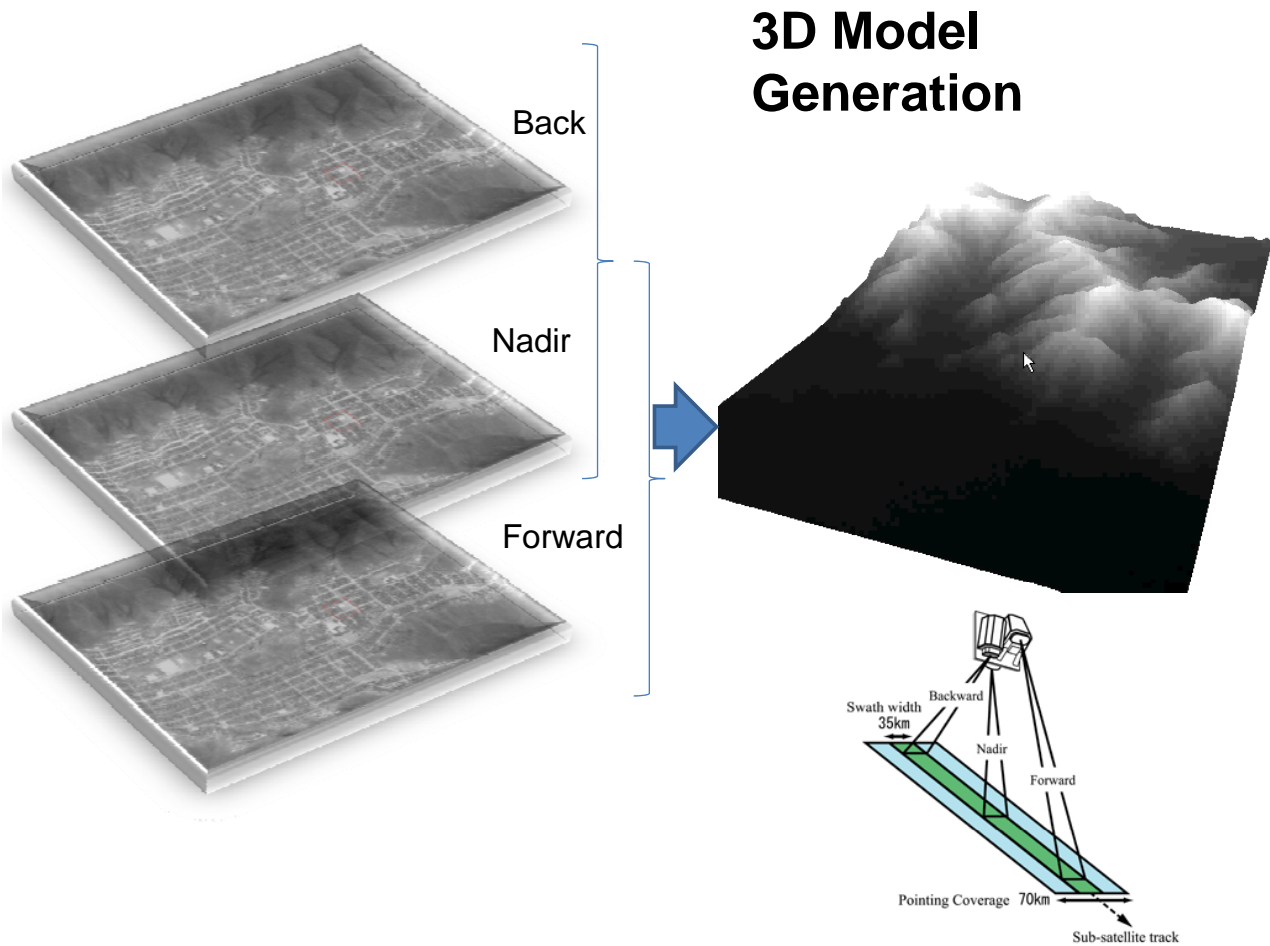
The classification model was even used to delineate the pool

# Normalized Difference Vegetation Index (from raster to vector)

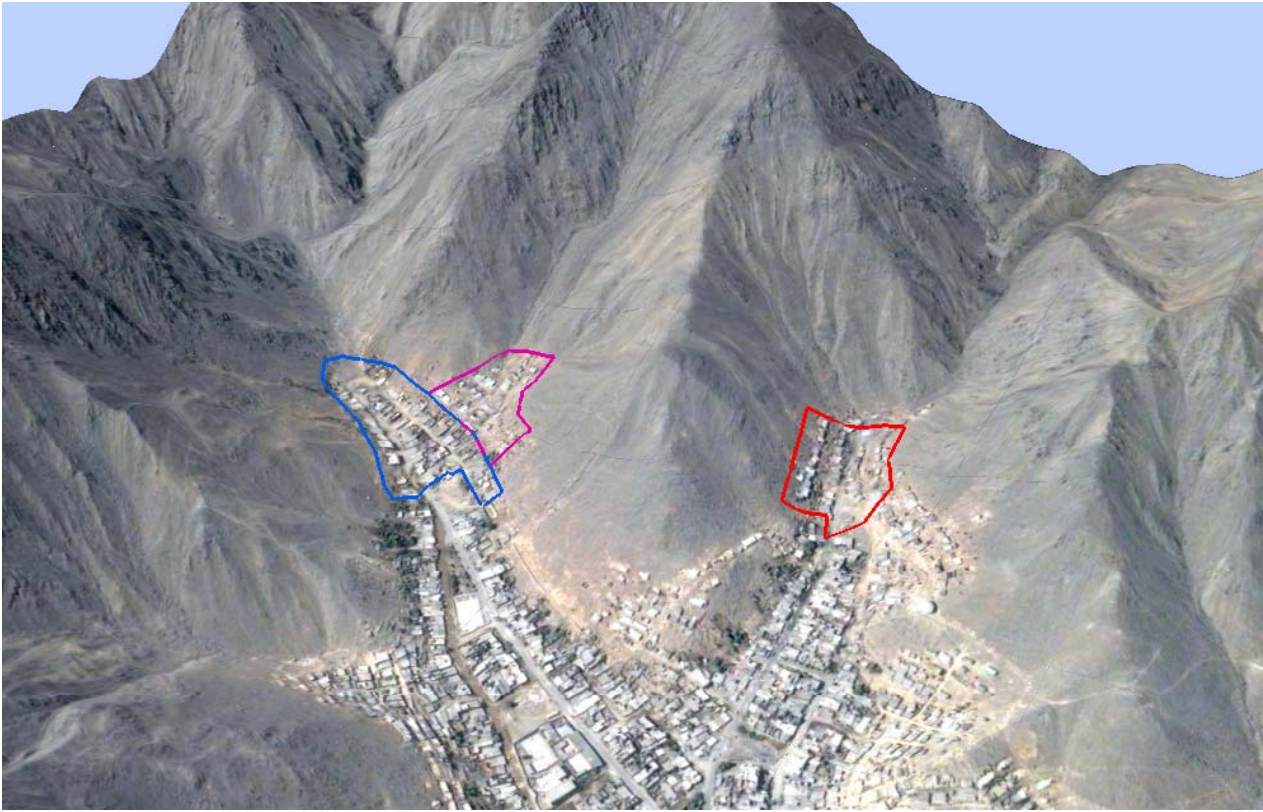


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## High Resolution Satellite Image overlaid on PRISM satellite DEM – Comas District



## Visual Image Comparison Satellite vs. Aerial Picture



# Human Resources Development



Field Survey in Lima



Field Survey in Lima



Technical Discussion



Group Meeting

## Coming Schedule for 2011-2012

### Geo-Spatial Database

Date	Topic	Organization
Sep. 2011	Field Survey in Lima and Tacna	Tokyo Tech., CISMID
2012	Development of Building Inventory	Tokyo Tech., CISMID

### Semi-Automatic Damage Detection using Remote Sensing

Date	Topic	Organization
2012	Calibration of Damage Detection Method	AIST, Chiba Univ., CISMID

### Damage Assessment of Scenario Earthquake

Date	Topic	Organization
2012	Development of Fragility Curves	CISMID, Tokyo Tech.