

# Enhancement of Earthquake and Tsunami Disaster Mitigation Technology in Peru -Research Plan-

January 2010

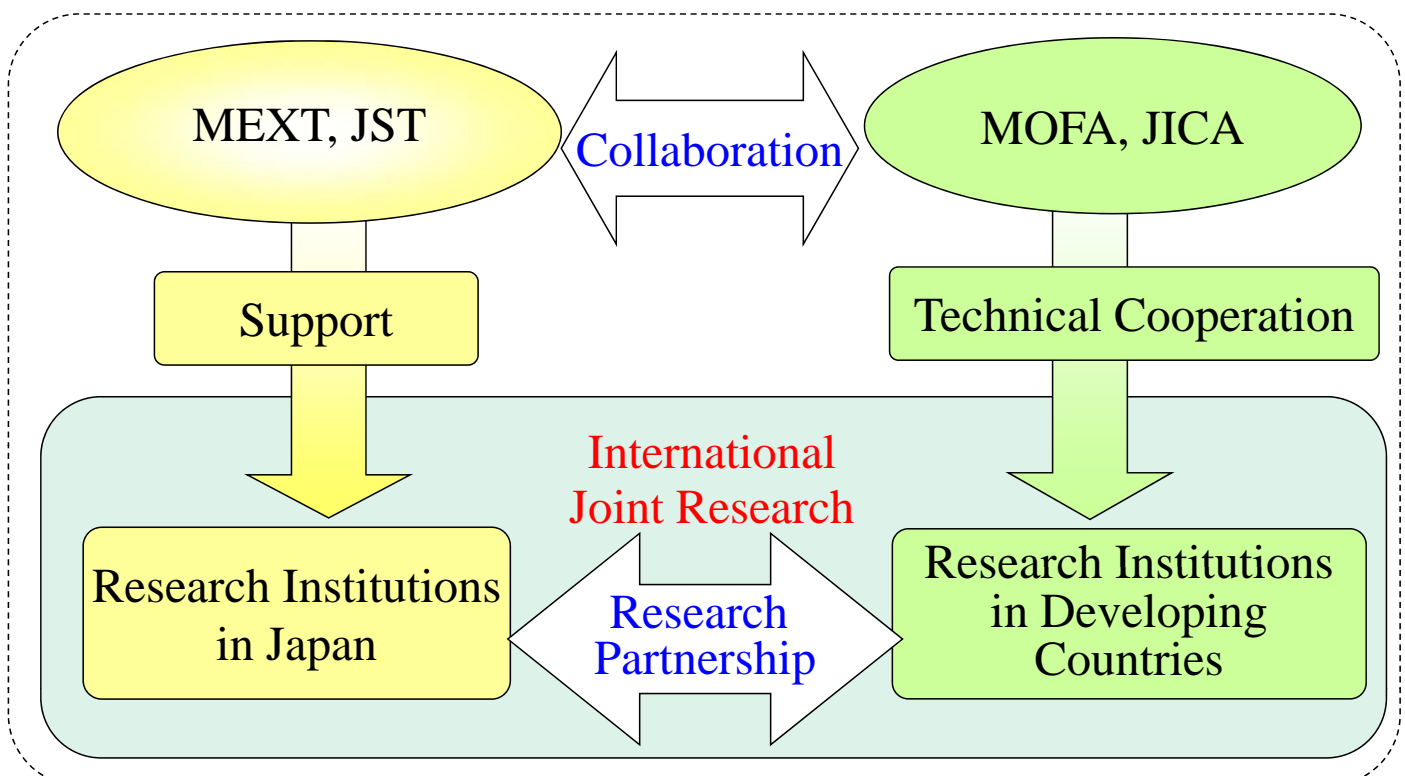
Principal Investigator: Fumio YAMAZAKI  
Chiba University, Japan

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## Science and Technology Research Partnership for Sustainable Development : SATREPS

<http://www.jst.go.jp/global/english/kadai.html>

[http://www.jica.go.jp/english/news/press/2009/090422\\_02.html](http://www.jica.go.jp/english/news/press/2009/090422_02.html)



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# Background of the Peru Project

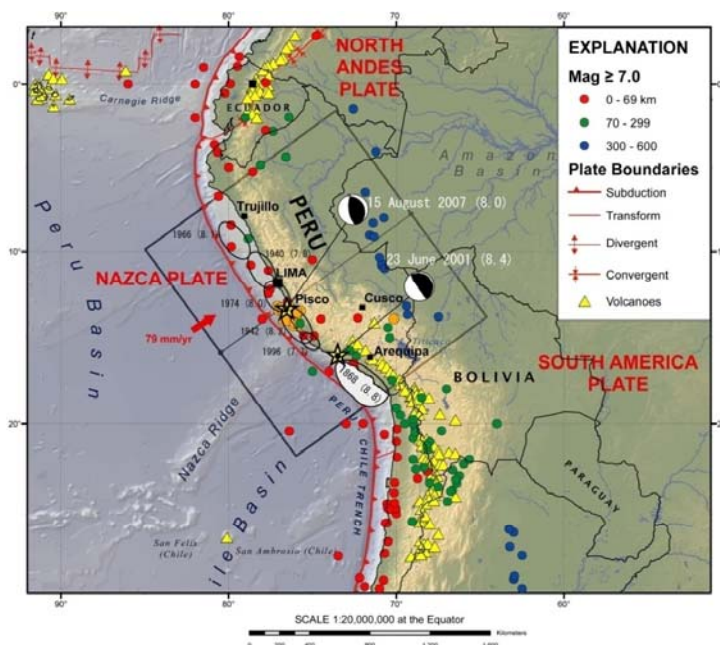
- **Earthquakes and tsunami** disasters are the major obstacles for sustainable developments in the **Asia-Pacific** region.
- In order to reduce disaster risks, **understanding of natural hazards** and **upgrading of societal resilience** are necessary.
- Since earthquakes and tsunamis are **rare** but **devastating** events, **the data collection and action** in a global scale is necessary.
- **Japan** is expected to serve a **leading role** in the promotion of international disaster mitigation.
  - **Hyogo Framework of Action 2005, ISDR**

ISDR: International Strategy of Disaster Reduction

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## Needs of EQ & T Disaster Mitigation in Peru (1)

- Peru locates in the **circum-Pacific seismic belt** with high seismic and tsunami risks.
- Large **inter-plate earthquakes** occurred in Atico (2001) and in Pisco (2007), and thus EQ & T disaster mitigation draws attention in Peru.



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## Needs of EQ & T Disaster Mitigation in Peru (2)

- Peru has a long term relationship with Japan since 1873.
- CISMID was established within UNI in 1987 by the support of Gov. of Japan. CISMID became the leading center of earthquake engineering research in South America.
- CISMID has been in collaboration with Japanese research institutions.



2008 APEC-Peru

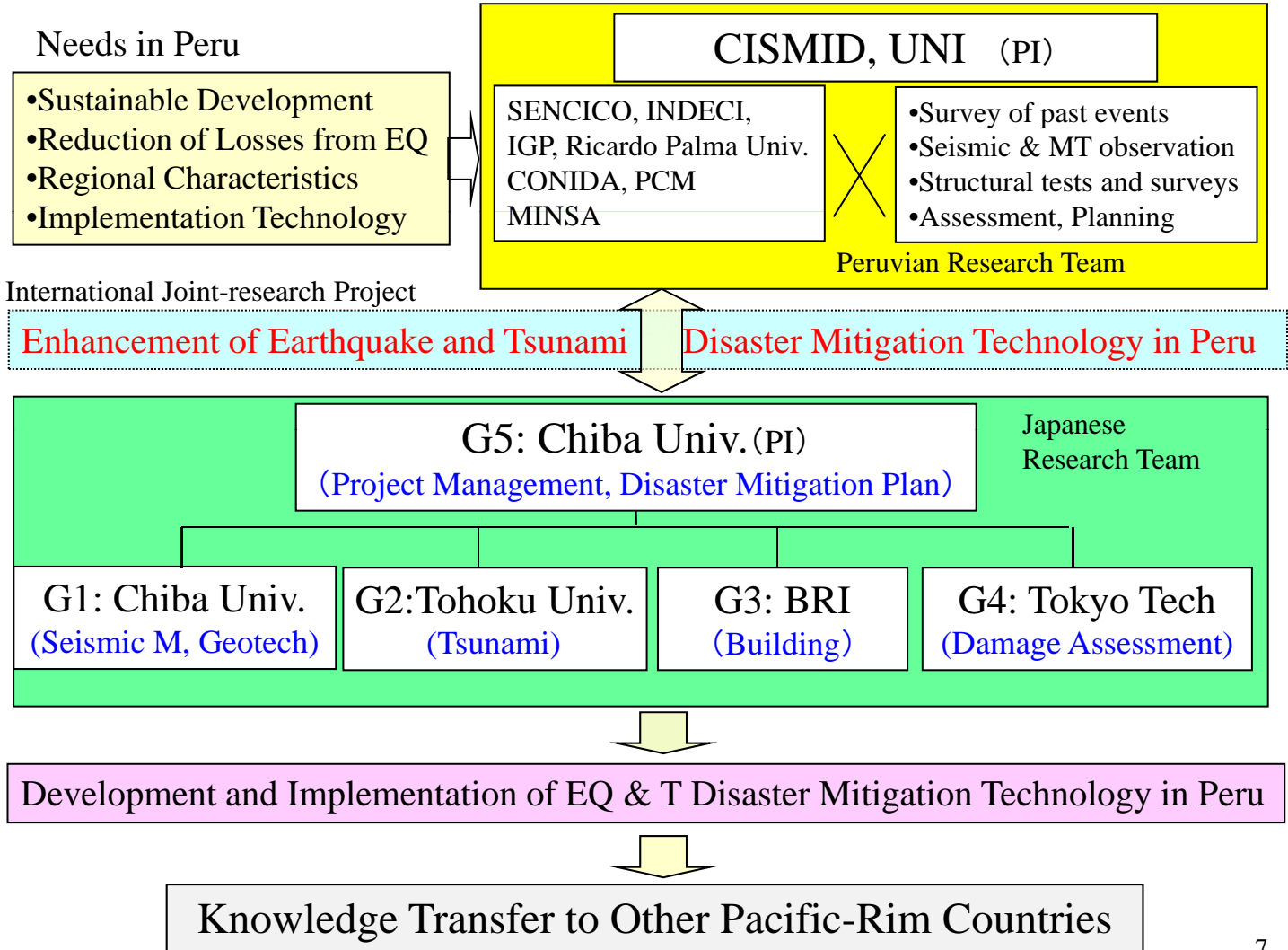
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## Significance of joint research between Peru and Japan

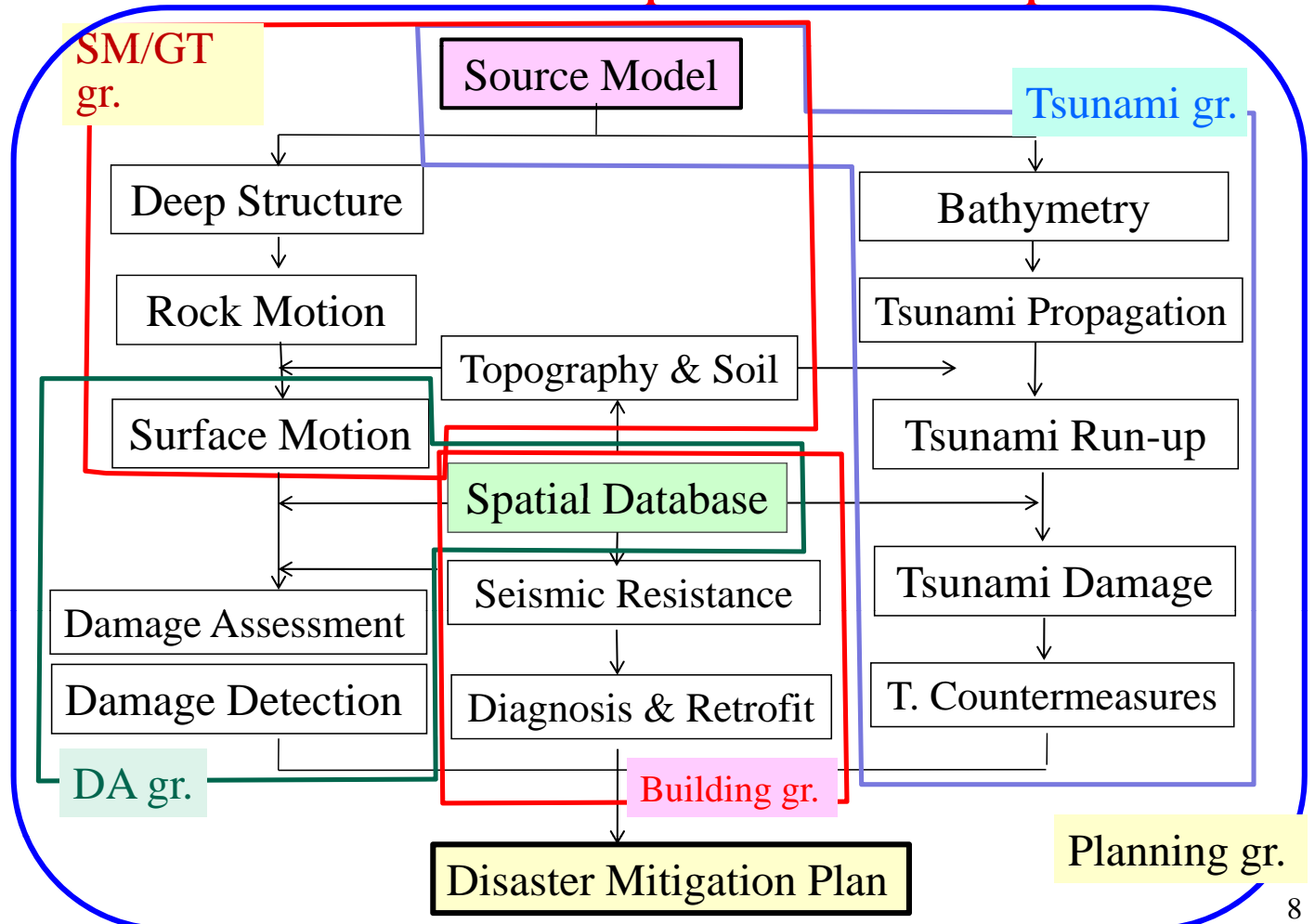
Both countries are located in a similar seismic environment, frequently hit by damaging EQ & T.

- Contribution of Japanese S & T to disaster mitigation in Peru
- Merits to Japanese geo-science since subduction-zone EQs are rare events
- Tsunamis caused by subduction-zone earthquakes in South America sometimes hit Japan (1960 Chile EQ). Thus the joint-research contributes to the tele-tsunami study in Japan.
- Promotion of disaster mitigation and capacity building through sharing the knowledge from the international joint research





## Research Topics and Groups



# Research Plan

## Project Management:

PI: Fumio Yamazaki (Chiba U)

【S. Nakai, S. Koshimura (Tohoku U), T. Saito (BRI), S. Midorikawa (TiTech)】

## Project Management and Coordination

- Project Management, International & domestic coordination
- Public relations, Information dissemination, Reports
- International workshops, Symposia



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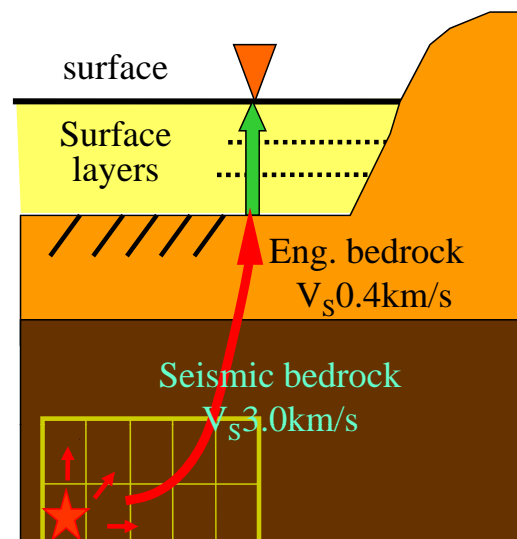
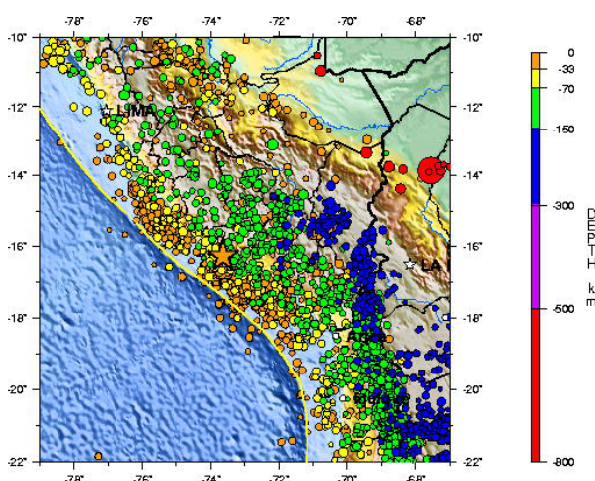
## G1: Seismic Motion and Geotechnical Issues

GL: Shoich Nakai (Chiba Univ.)

【H. Yamanaka (TiTech), N. Pulido (NIED), H. Arai (BRI), T. Sekiguchi】

### 1-1 Source Modeling and Prediction of Seismic Motion

- Collection of historical EQ data and seismic records, Scenario EQs
- Prediction of engineering bedrock motion
- Development of ground structures based on seismic and microtremor observations



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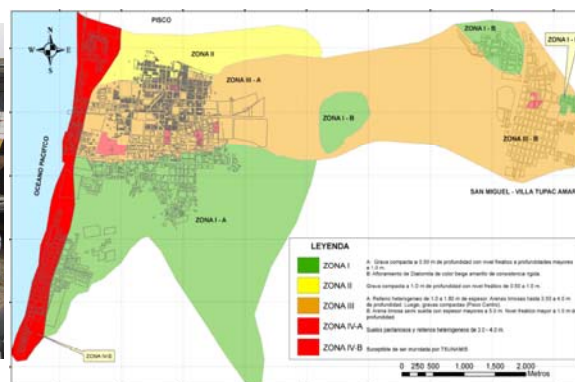
# G1: Seismic Motion and Geotechnical Issues (2)

## 1-2 Microzonation based on EQ and MT observations

- Determination of S-wave structures based on EQ and MT observations
- Liquefaction assessment based on borehole survey and laboratory tests
- Microzonation of surface layers based on seismic response analysis

## 1-3 Risk Assessment of Slope Failures

- Development of risk maps for houses on steep slopes
- Site amplification and damage assessment based on topography



# G2: Tsunami Simulation and Damage Mitigation

GL: Shun'ichi Koshimura (Tohoku Univ.)

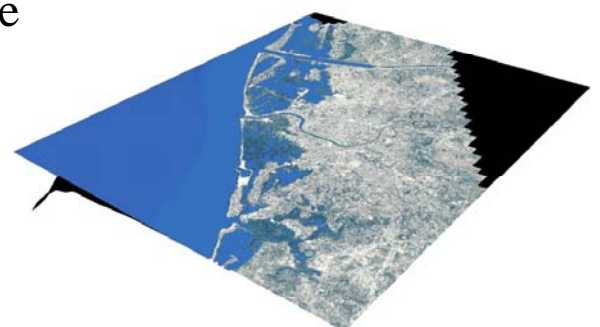
[Y. Yagi & G. Shoji (Tsukuba U), Y. Fuji (BRI)]

## 2-1 Tsunami Source, Propagation and Impacts

- Assess historical tsunami events and their impacts in Peru
- Numerical simulation of tsunami propagation and runup
- Identify potential tsunamis and the worst case scenarios

## 2-2 Tsunami Hazard and Impacts Mapping

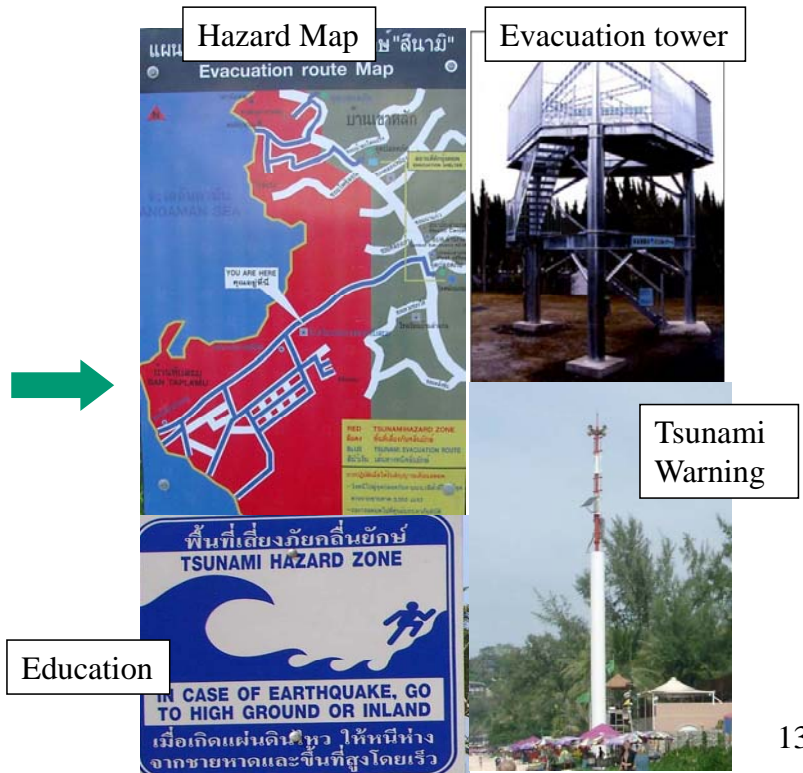
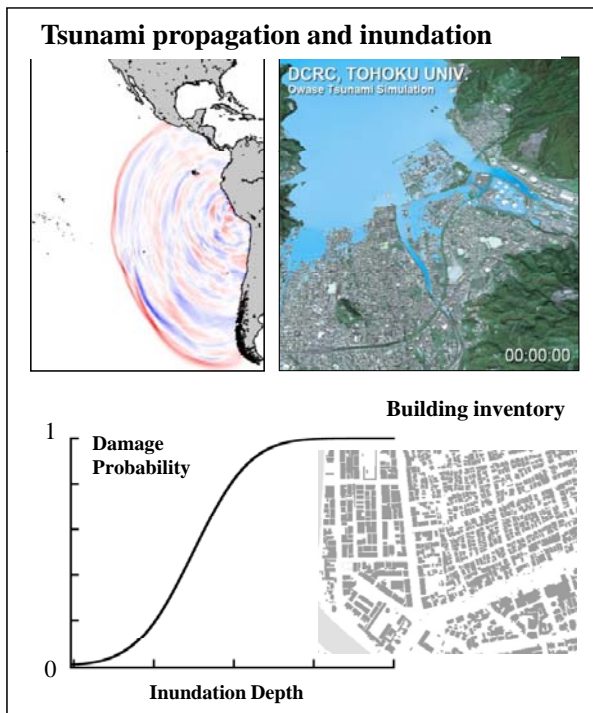
- Inundation modeling and building damage
- Tsunami impacts to infrastructures



# G2: Tsunami Simulation and Damage Mitigation (2)

## 2-3 Implementation of Tsunami DM Technology

- Develop a general procedure for mapping tsunami hazard
- Strategic planning to mitigate tsunami risks and damage



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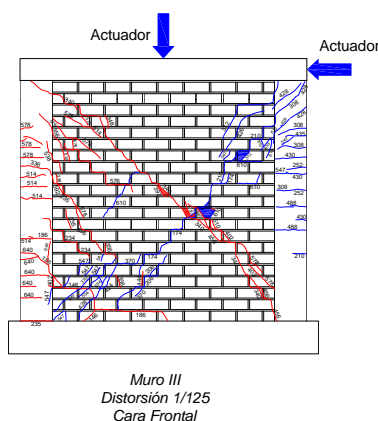
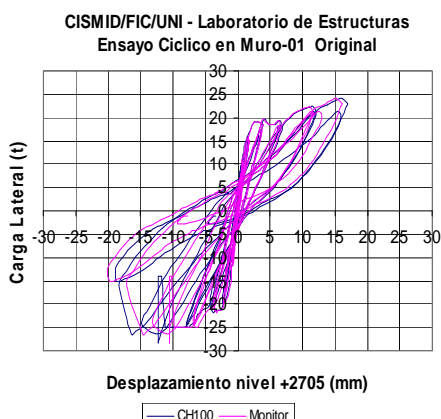
# G3: Enhancement of Seismic Resistance of Buildings

GL: Taiki Saito (BRI)

【M. Teshigawara (Nagoya U), K. Kusunoki (Yokohama N. U.), C. Cuadra (Akita P. U.), S. Sugano】

## 3-1 Develop database of structural test results for masonry buildings

- Collection of results of structural tests
- Development of a database of testing for masonry structures



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## G3: Enhancement of Seismic Resistance of Buildings (2)

### 3-2 Develop Seismic Diagnosis and Retrofit Technologies

- Develop seismic-diagnosis and retrofit technologies for different types of buildings prevalent in Peru
- Introduction of advanced seismic control technologies
- Verify the effects of retrofit technology by structural tests and analyses

### 3-3 Assessment and Retrofit of Historical Buildings

- Identify historical buildings that face significant EQ disaster risks
- Survey of historical buildings and develop their retrofit technologies



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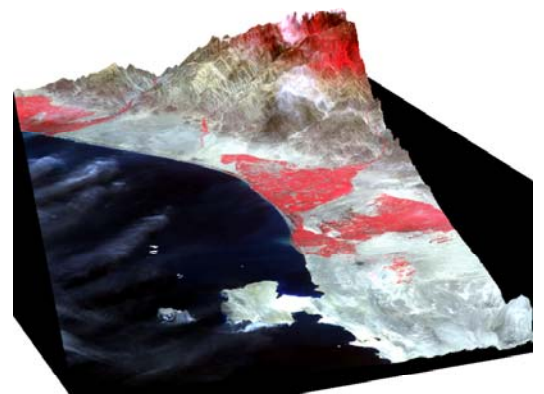
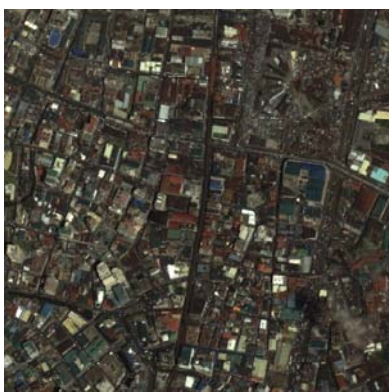
## G4: Geo-spatial Database and Damage Assessment

GL: Saburo Midorikawa (Tokyo Tech)

【M. Matsuoka (AIST), H. Miura, Y. Maruyama (Chiba u)】

### 4-1 Development of Geo-spatial Database

- Development of land-use maps using satellite images
- Development of building inventory using high-resolution satellite images
- Development of digital surface model using ASTER & ALOS images



Ikonos images and building inventory

ASTER/DEM for Pisco area (AIST) 16



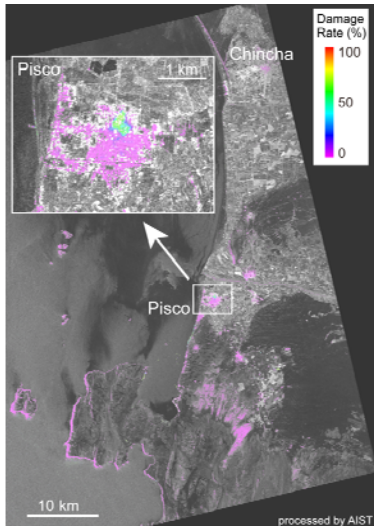
# G4: Geo-spatial Database and Damage Assessment (2)

## 4-2 Damage Detection using Satellite Images

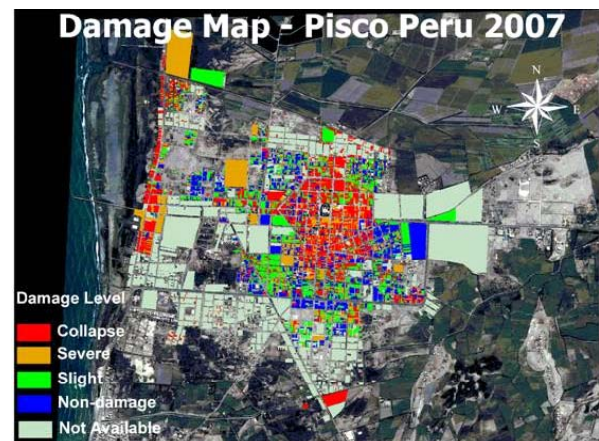
- Earthquake damage detection of urban areas using optical/SAR images
- Detection of slope failures using optical/SAR images and DEM

## 4-3 Damage Assessment for Scenario Earthquakes

- Predicting earthquake disaster losses of the study areas
- Visualization of the assessment result on GIS



Damage map estimated from ALOS/PALSAR image



Damage survey by CISMID

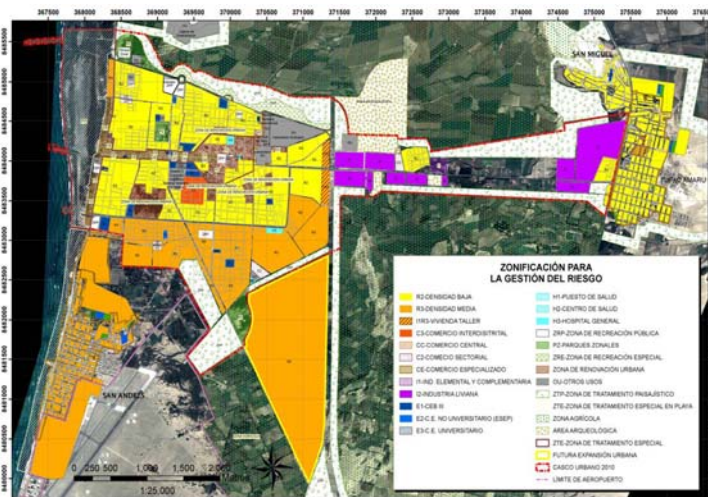
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# G5: Development of Disaster Mitigation Plan

GL: Fumio Yamazaki (Chiba U)

【H. Kanegae (Ritsumeikan U), H. Kaji (TiTech), M. Muraki, all the GLs】

- Formulate land-use policies for mitigation of EQ & T disasters
- Develop local disaster mitigation plans for the study areas
- Awareness raising and dissemination activities for disaster management organizations and local communities



Land-use plan after the 2007 Pisco EQ (CISMID)



Technical seminar (JICA-Peru, 2004)

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# Schedule of the Research Project

Research Items	Period (2010-2014)				
	1 st	2 nd	3 rd	4 th	5 th
<b>Project Management</b> 【Chiba U and CISMID/UNI】	WS▼ ←	WS▼	WS▼	WS▼	WS▼ →
<b>G1: Seismic motion &amp; Geotechnical</b> 【Chiba U and CISMID, IGP】 1-1 Source modeling and seismic motion 1-2 Site response & Microzonation 1-3 Slope failure assessment	← Source modeling	← Simulation of SM	← EQ and MT observation, Geological survey	← Microzonation	← Hazard map
<b>G2: Tsunami</b> 【Tohoku U and DHN, CISMID】 2-1 Tsunami propagation and impacts 2-2 Tsunami hazard mapping 2-3 Tsunami DM technology	← Tsunami simulation	← Inundation and impact	← Data collection	← Damage assessment method	← Tsunami damage analysis
<b>G3: Buildings</b> 【BRI and CISMID】 3-1 Seismic tests database 3-2 Diagnosis and Retrofit 3-3 Retrofit of historical buildings	← Literature Survey, Tests	← Develop diagnosis method	← Survey, Risk assessment	← Database development	← Retrofit technology, Validation tests
<b>G4: Damage Assessment</b> 【Tokyo Tech and CISMID, CONIDA】 4-1 Geo-spatial database 4-2 Damage detection using RS 4-3 Damage assessment for Scenario EQ	← Data collection	← Geospatial data	← Data collection	← Methodology	← Database development
<b>G5: Disaster Mitigation Plan</b> 【Chiba U and INDECI, CISMID】	← Literature Survey	←	←	← Planning	← Dissemination, Education

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## Expected Outputs

1. Scenarios of large-magnitude inter-plate earthquakes are identified which will cause the most significant losses in Peru (G1, G2).
2. Geographical information of the study areas is prepared (G4).
3. Tsunami disaster losses in study areas by scenario earthquakes are estimated, and mitigation technologies are developed (G2).
4. Strong motion and ground failure in study areas by scenario earthquakes are simulated (G1).
5. Earthquake disaster losses in study areas by scenario earthquakes are estimated, and mitigation technologies are developed (G4).
6. Technologies for evaluation of seismic-resistance and structural retrofit are developed, adapting to building characteristics of Peru (G3).
7. Earthquake/tsunami disaster mitigation is promoted in the study areas (G5).