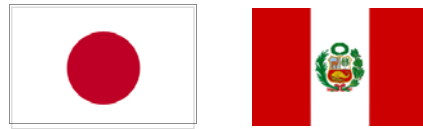


# Enhancement of Earthquake and Tsunami Disaster Mitigation Technology in Peru



March 10, 2011

Fumio YAMAZAKI



Professor, Chiba University, Japan.  
Doctor Honoris Causa, UNI, Peru.

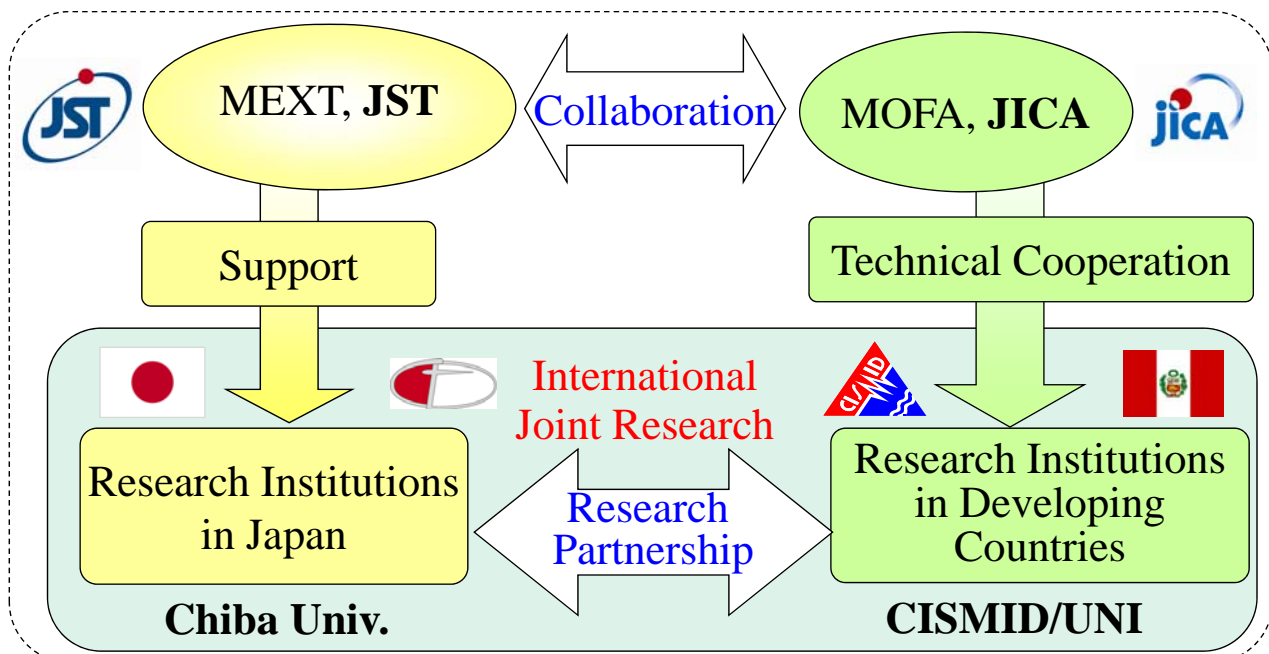


## Science and Technology Research Partnership for Sustainable Development : **SATREPS**

- 1) Environment and Energy
- 2) Bioresources
- 3) **Natural Disaster Prevention**
- 4) Infectious Diseases Control

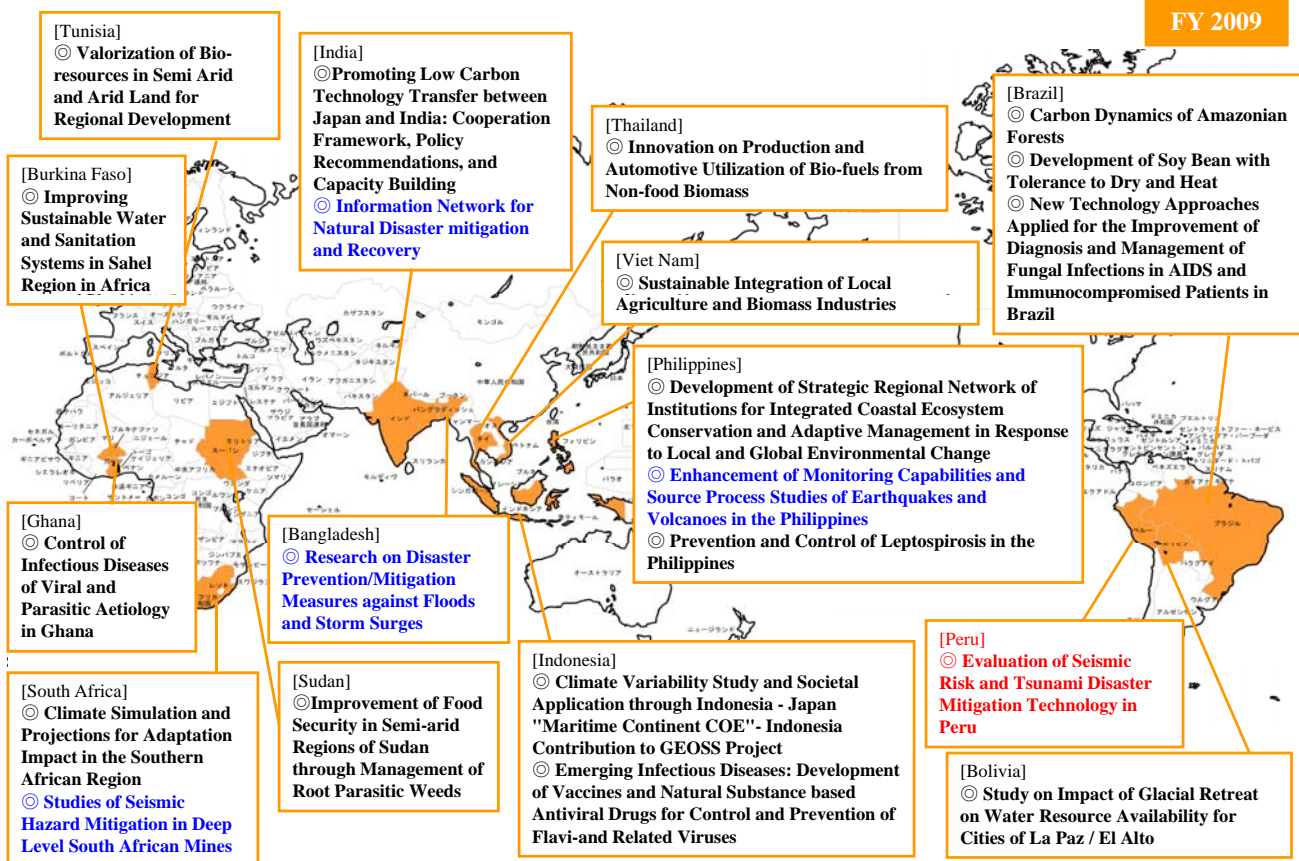
*JST: Japan Science and Technology Agency*

*JICA: Japan International Cooperation Agency*



# Selected Projects of SATREPS for FY2009

FY 2009

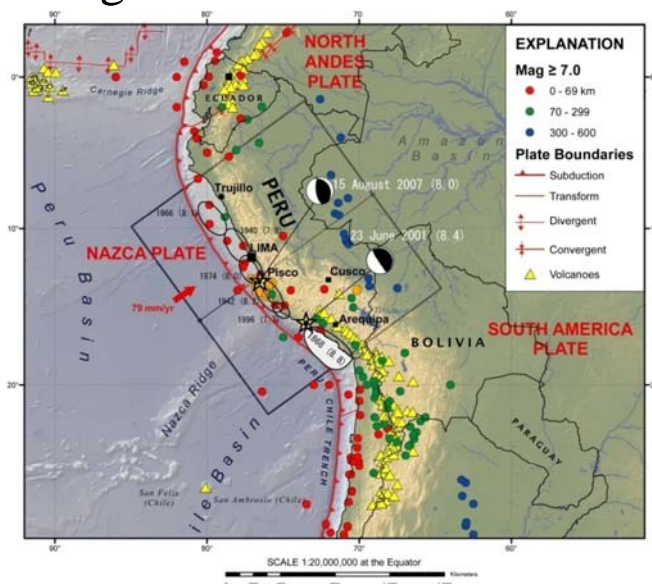


3

## 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 significant **attention in Peru**.



4

## 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

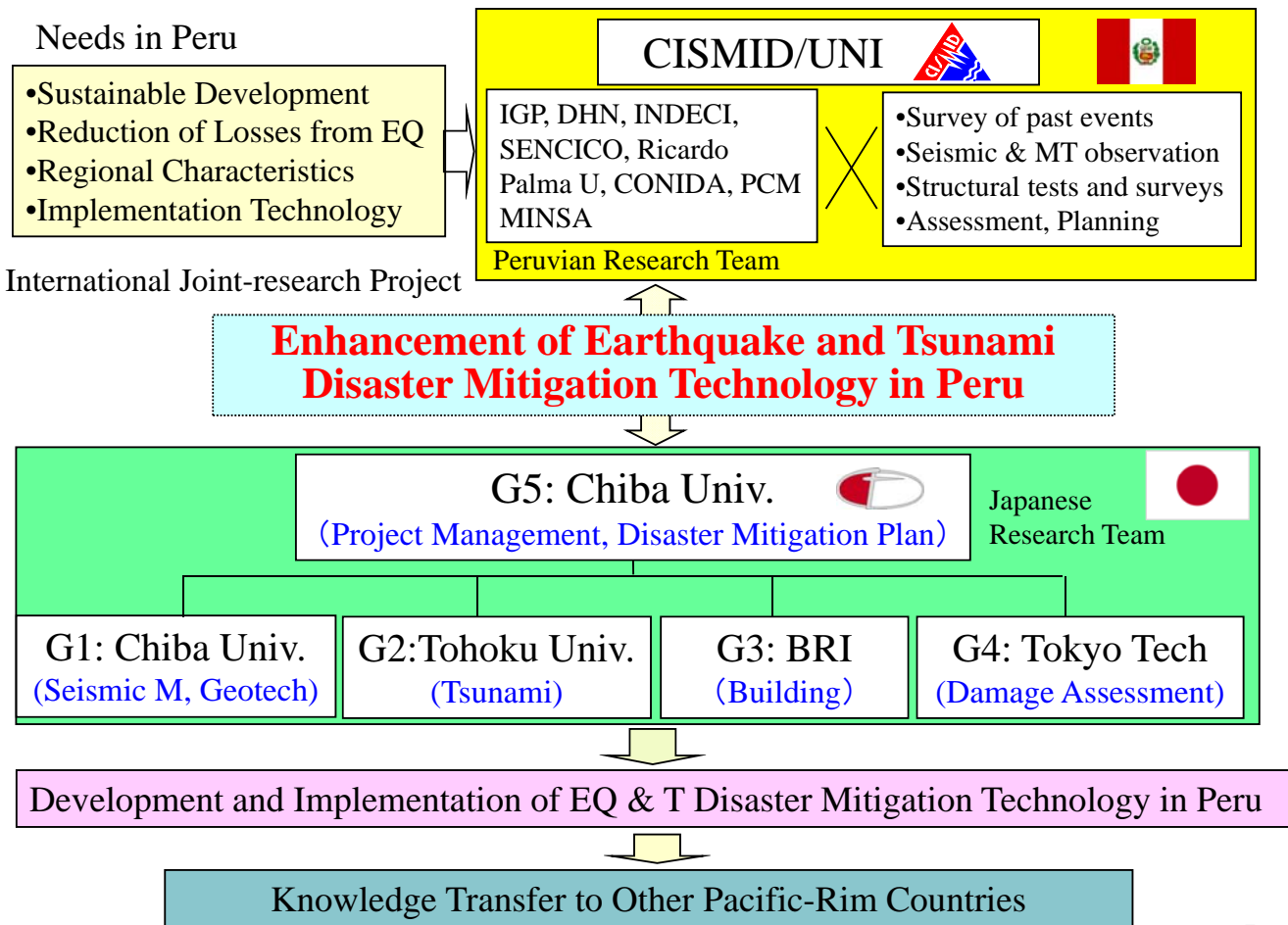
5

## Significance of joint research between Peru and Japan

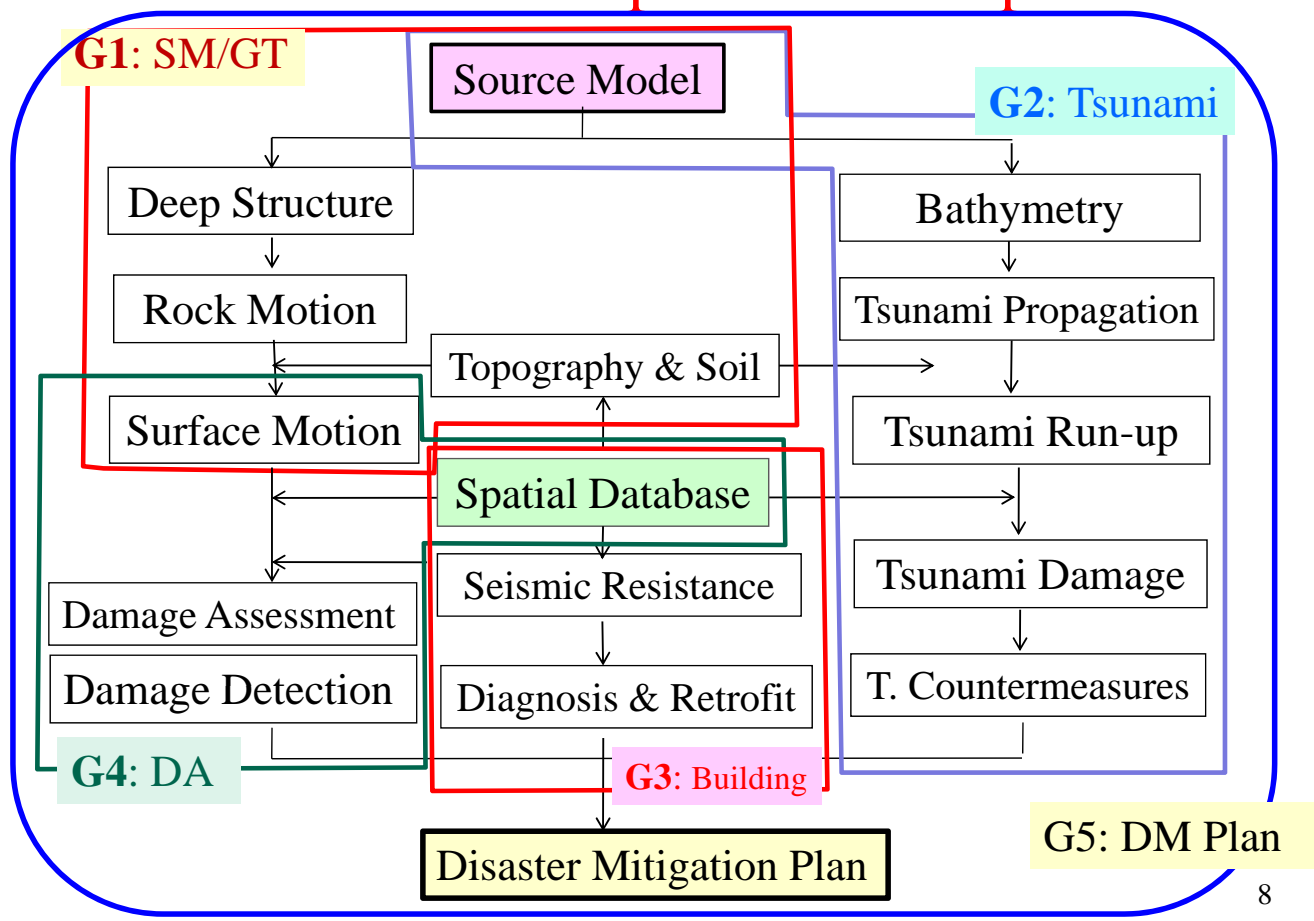
Both countries are located in a similar seismic environment, frequently hit by damaging EQ & T.

- **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, 2010 Chile EQs). 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 and Coordination

PI: F. Yamazaki (Chiba U), C. Zavala (CISMID/UNI)

- Project Management, International & domestic coordination
- Public relations, Information dissemination
- International workshops, symposia <http://ares.tu.chiba-u.jp/peru/>

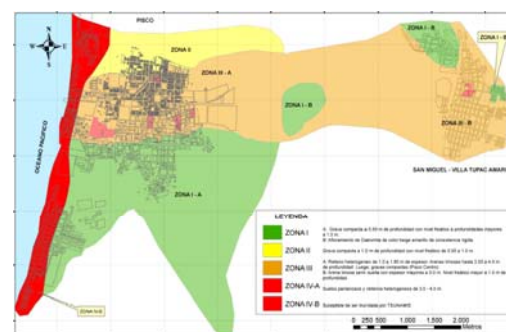
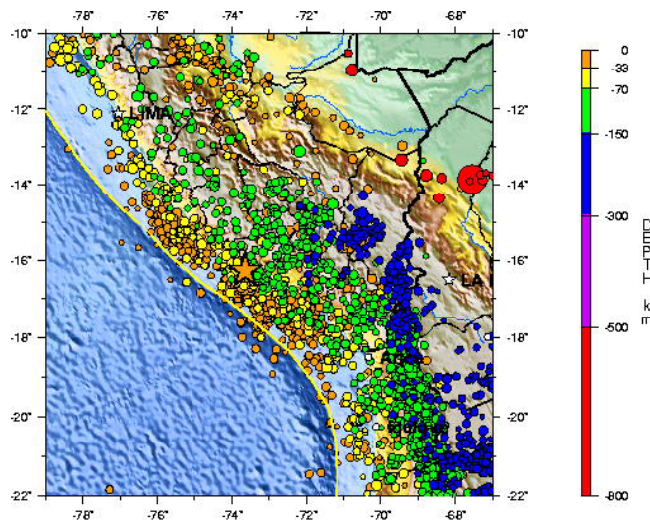


9

## G1: Seismic Motion and Geotechnical Issues

GL: S. Nakai (Chiba U), Z. Aguilar (UNI) & IGP

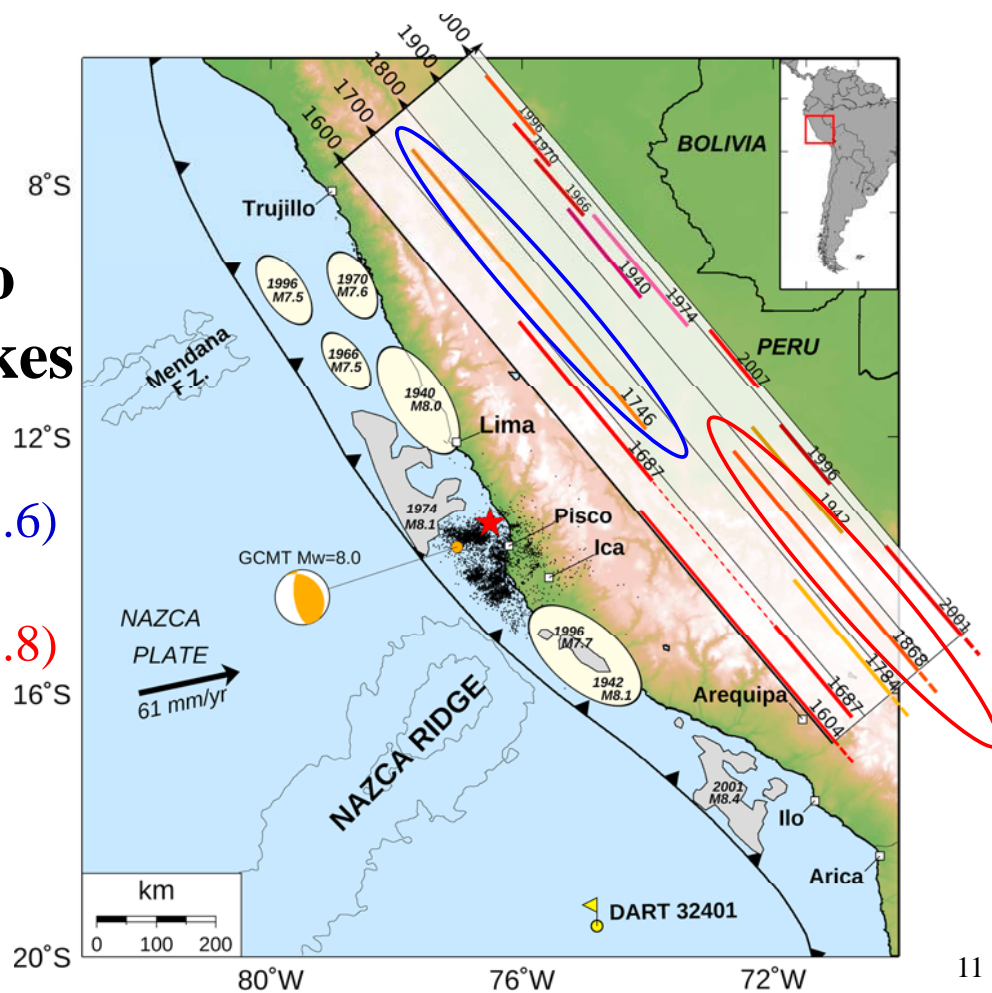
- Source Modeling and Simulation of Seismic Motion
- Microzonation based on EQ and MT observations
- Risk Assessment of Slope Failures



10

# Scenario Earthquakes

1746 ( $M_w=8.6$ )  
and  
1868 ( $M_w=8.8$ )



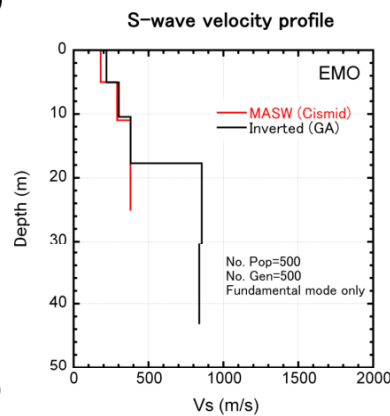
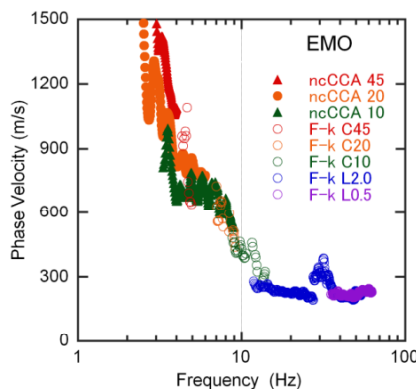
## Array microtremor observation at planned seismometer sites in Lima



Array microtremor measurement in Lima on Sept. and Dec., 2010



Observation sites in Lima

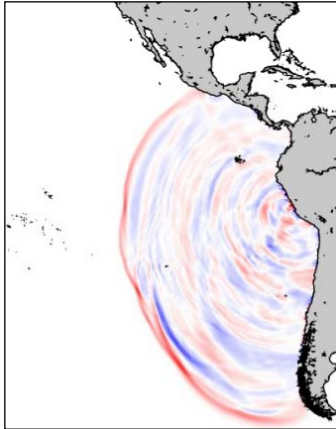


Dispersion curve and estimated Vs profile

## G2: Tsunami Simulation and Damage Mitigation

GL: S. Koshimura (Tohoku U), DHN & IGP

- Tsunami Source, Propagation and Impacts
- Tsunami Hazard and Impacts Mapping
- Implementation of Tsunami Disaster Mitigation Technology

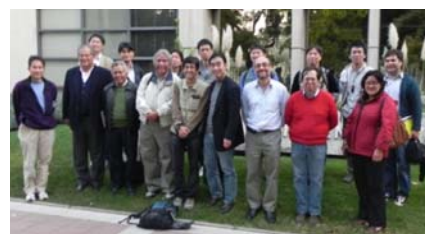


13

## G3: Seismic Resistance of Buildings

GL: T. Saito (BRI), C. Zavala (UNI)

- Develop Database of Structural Tests for Masonry Buildings
- Develop Seismic Diagnosis and Retrofit Technologies
- Assessment and Retrofit of Historical Buildings

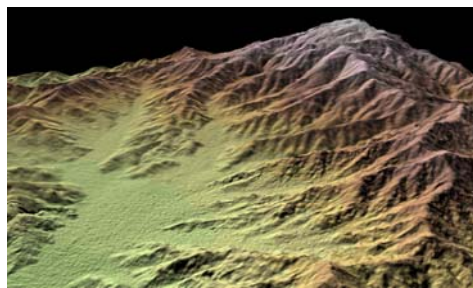


14

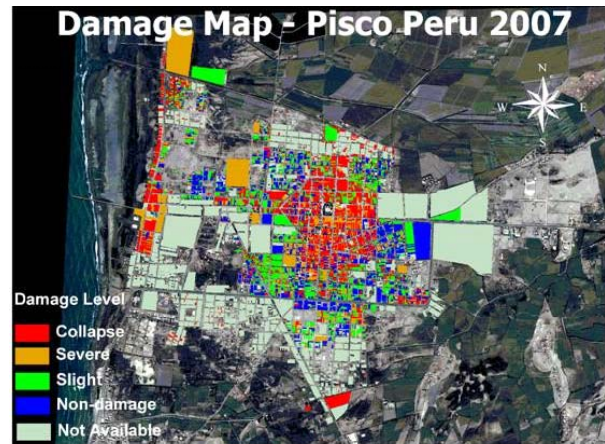
# G4: Geo-spatial Database and Damage Assessment

GL: S. Midorikawa (Tokyo Tech), M. Estrada (UNI)

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



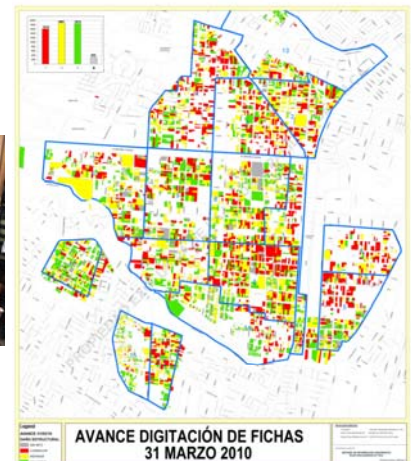
2.5m DEM by ALOS/PRISM



## 2010 Chile EQ joint survey (G4+G5) by 5 SATREPS members



Talca city hall



## Comparison of satellite images in Talca



(a) Before EQ  
2008/1/1 QuickBird



(b) After EQ  
2010/3/10 WV



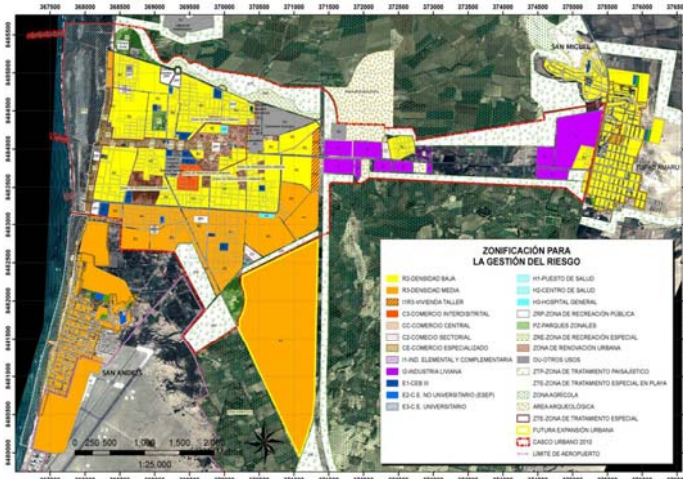
(C) GIS damage map



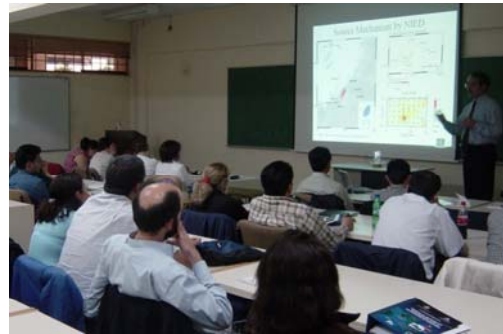
# G5: Development of Disaster Mitigation Plan

GL: F. Yamazaki (Chiba U), A. Bisbal (INDECI)

- Formulate **Land-use Policies** for Disaster Mitigation
- Develop **Local Disaster Mitigation Plans** for the **Study Areas**
- **Awareness Raising and Dissemination Activities**



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



Technical seminar (JICA-Peru, 2004)

## G5 Activities in 2010

Selection of target areas and field survey

Public Relations

Meeting with INDECI



Field survey in Tacna



Seminar at Peruvian Congress



Recovery survey in Pisco



Meeting at Tacna Private Univ.



# 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 EQ and MT observation, Geological survey Field survey, measurement	Simulation of SM		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 Data collection Historical tsunami data	Inundation and impact 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 Retrofit Technology		Guideline Guideline
<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 Data collection Damage assessment method	Geospatial data Methodology	Database development Damage detection Assessment, risk map		
<b>G5: Disaster Mitigation Plan</b> 【Chiba U and INDECI, CISMID】		Literature Survey	Planning	Dissemination, Education	

19

## 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).



**Thank you very much!**  
**Muchas Gracias!**  
ご清聴ありがとうございます。