

# The Global Earthquake Model (GEM) - Working together to assess risk -

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Dr. Carlos Villacis

Regional Program Manager & Strategy Coordinator

GEM Foundation



working together  
to assess risk

**GEM**  
GLOBAL EARTHQUAKE MODEL

**OO**  
OPENQUAKE

# Overview

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- Introduction to GEM
- Urban risk assessment at GEM
- Pre-Disaster Shelter Planning

# A TRUE PUBLIC-PRIVATE PARTNERSHIP

## PRIVATE

Munich RE 

  
ZURICH®

 AIR WORLDWIDE

Willis

 EUCENTRE  
European Centre for Training and Research in Earthquake Eng

hannover re®

FM Global

suramericana 

Renaissance Re  
RISK SCIENCES FOUNDATION, INC.

 Swiss Re  
Foundation

ARUP

OYO

Nephila



General Insurance Policy  
Supervisor of Japan

 The Research Council  
of Norway

 NANYANG  
TECHNOLOGICAL  
UNIVERSITY

 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra



## ASSOCIATES



EE  
RI



ICSU  
International Council for  
Science



Turkey

 NATURAL  
ENVIRONMENT  
RESEARCH COUNCIL

United Kingdom

 USAID  
FROM THE AMERICAN PEOPLE

United States

 funvisis  
Fondación Venezolana de  
Investigación Sísmica

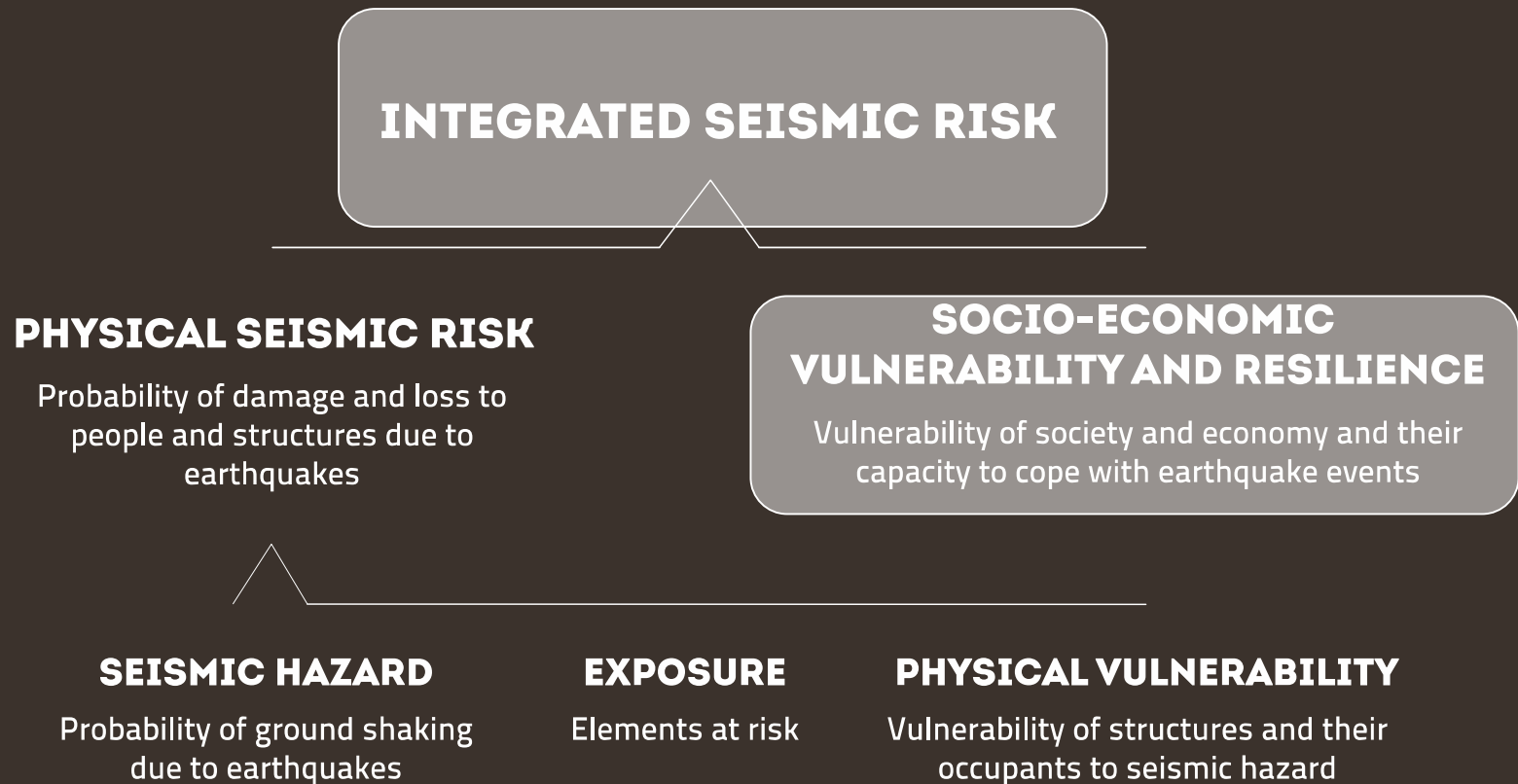
Venezuela

More than 25 public & private organisations and  
16+ countries fund and govern the  
GEM Foundation

To apply science for transparent assessment of  
earthquake risk to inform disaster risk reduction



# What GEM does - Scientific Framework

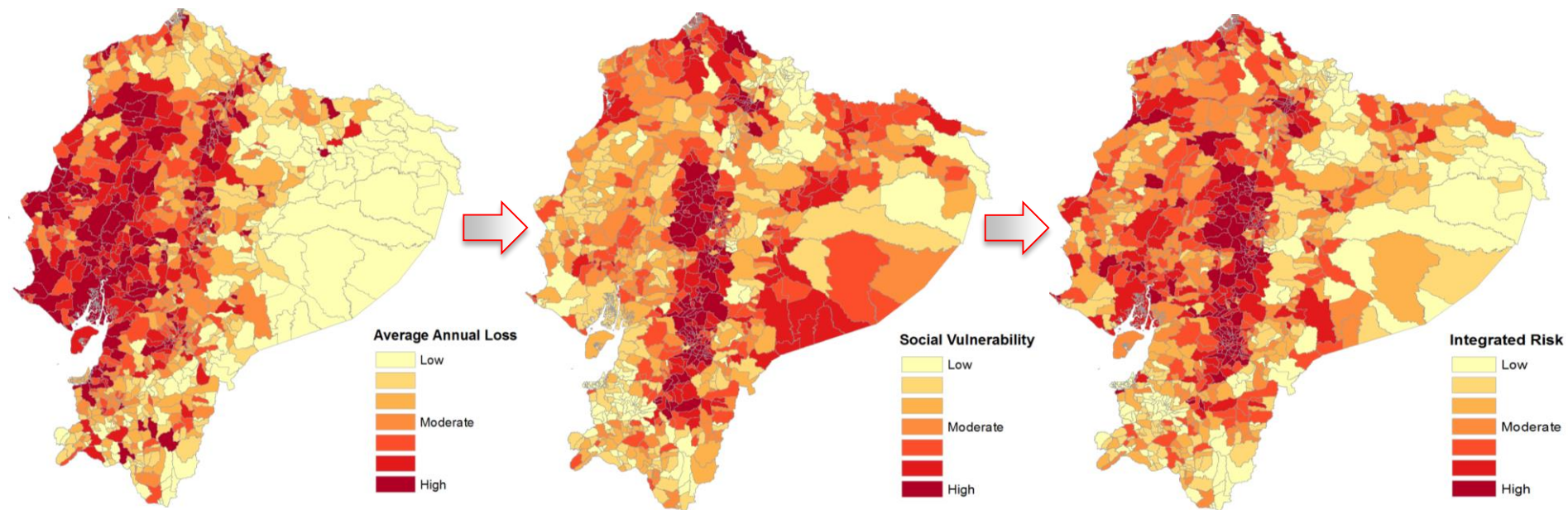


# Ecuador: Integrated Risk Modelling in OpenQuake

Physical Seismic Risk

Social Vulnerability

Integrated Risk

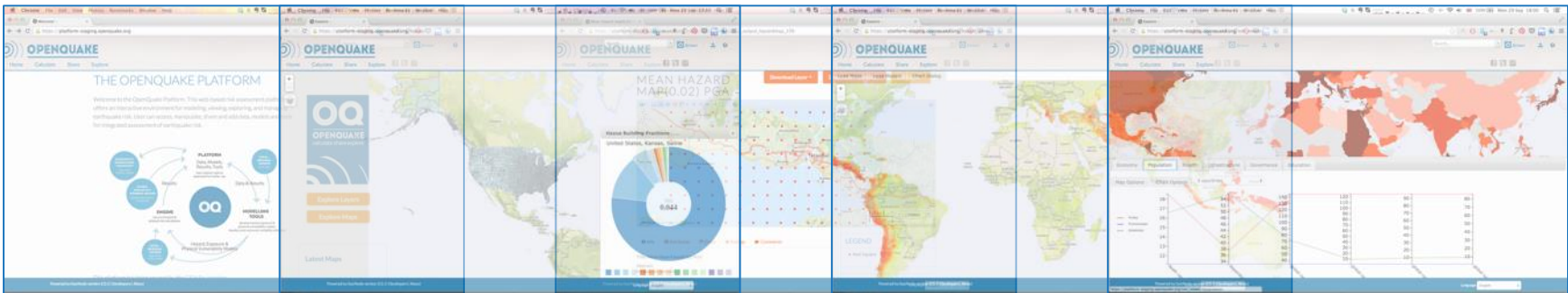


# OpenQuake Platform

Calculate

Share

Explore



**OPEN-SOURCE  
TOOLS**

**BEST  
PRACTICE**

**DATA**

**RISK  
INFORMATION**

**MODELS**

**USER  
SUPPORT**

Standalone & web-based tools, including the OpenQuake Engine

Technical reports, wikis, guidelines, case-studies, knowledge sharing apps

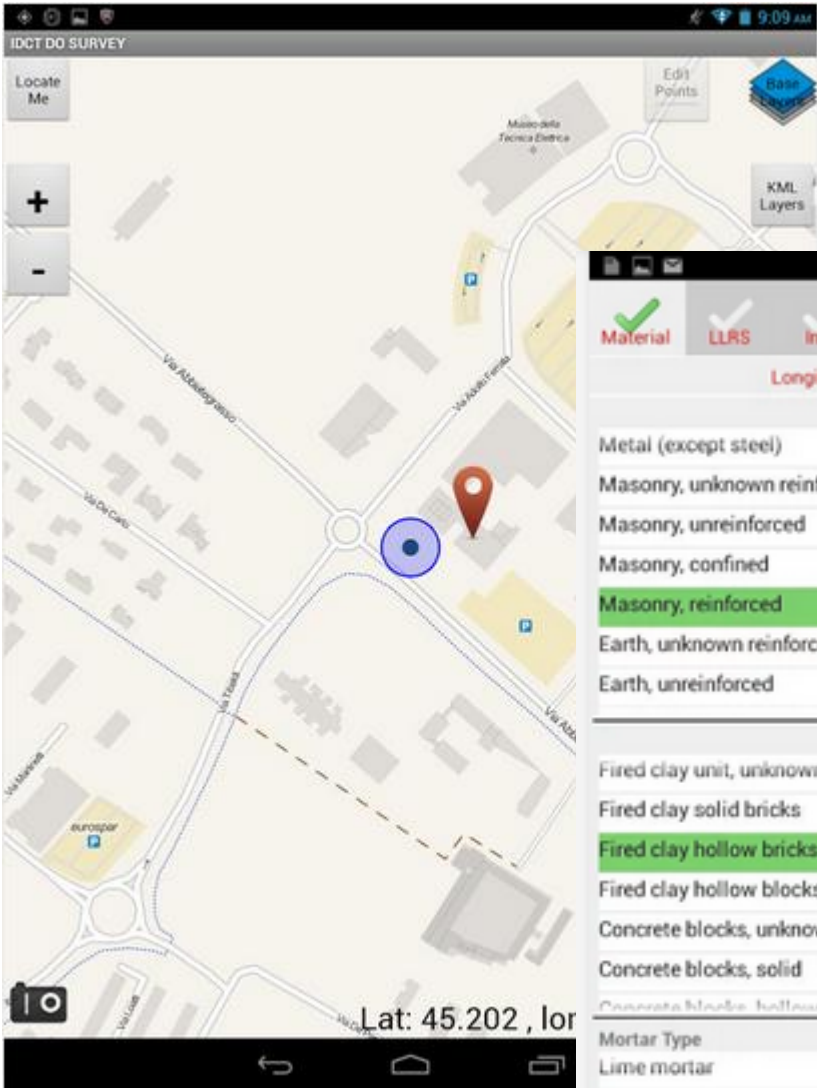
Global harmonised datasets that will grow over time

Hazard & risk maps, stochastic event sets, curves

Regional & national models to run with the OpenQuake Engine

User guides & tutorials

# IDCT Android Data Collection Tool



Material LLRS Irreg Comm. Roof Floor Occu AgeHght Exp Conseq

Longitudinal Transverse

Material Type

Metal (except steel)

Masonry, unknown reinforcement

Masonry, unreinforced

Masonry, confined

Masonry, reinforced

Earth, unknown reinforcement

Earth, unreinforced

Material Tech

Fired clay unit, unknown type

Fired clay solid bricks

Fired clay hollow bricks

Fired clay hollow blocks or tiles

Concrete blocks, unknown type

Concrete blocks, solid

Mortar Type

Lime mortar

Cement mortar

Cement:lime mortar

Unknown stone type

Limestone

Masonry Reinforcement

Unknown reinforcement

Steel-reinforced

Wood-reinforced

Bamboo-, cane- or rope-reinforced

Fibre reinforcing mesh

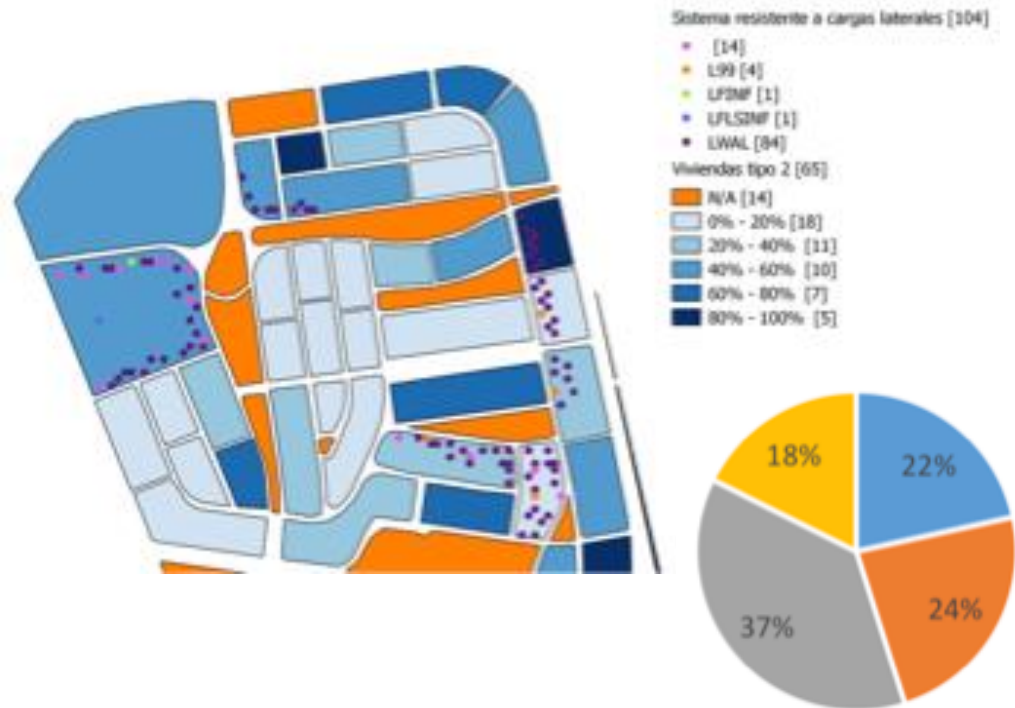
## Braced frame [LFBR]

A framework of beams and columns in which inclined, often diagonal, structural members brace the building and provide strength and rigidity. The bracing can take a variety of forms. If diagonal members are stocky they resist both tension and compression forces. However if slender, they resist tension forces only. Usually, braced frame members are triangulated and meet at joints (similar to a vertical truss). Eccentrically braced frame members - their inclined members are braced in order to create ductile fuse regions in the beam or may not be infilled.

Diagram illustrating a braced frame structure (A. Architects, Architectural Press 2008, p64).

Close

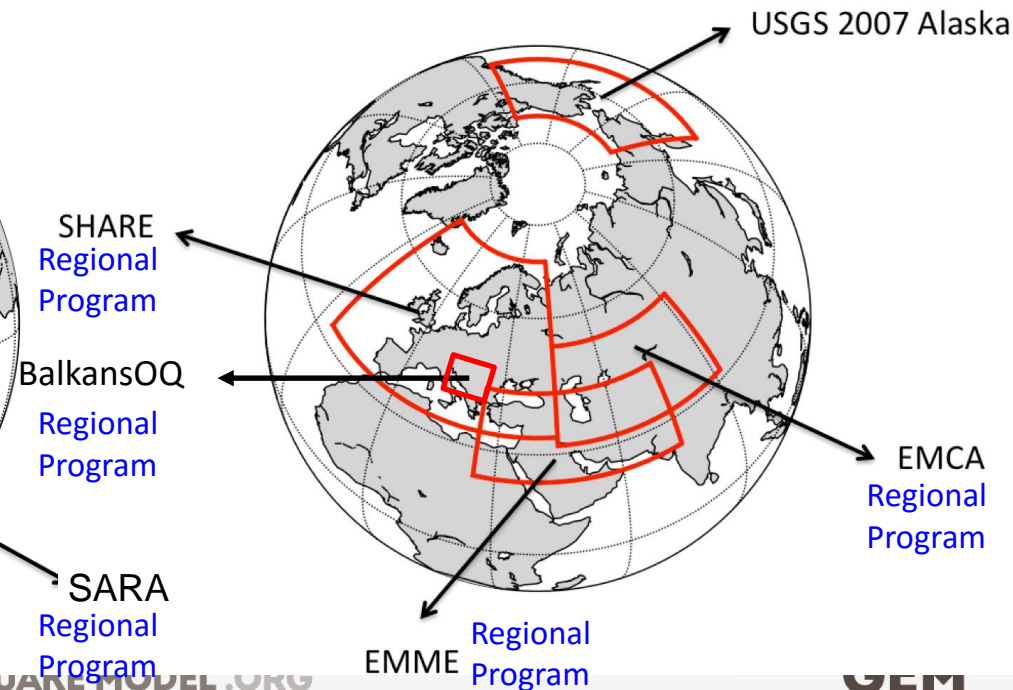
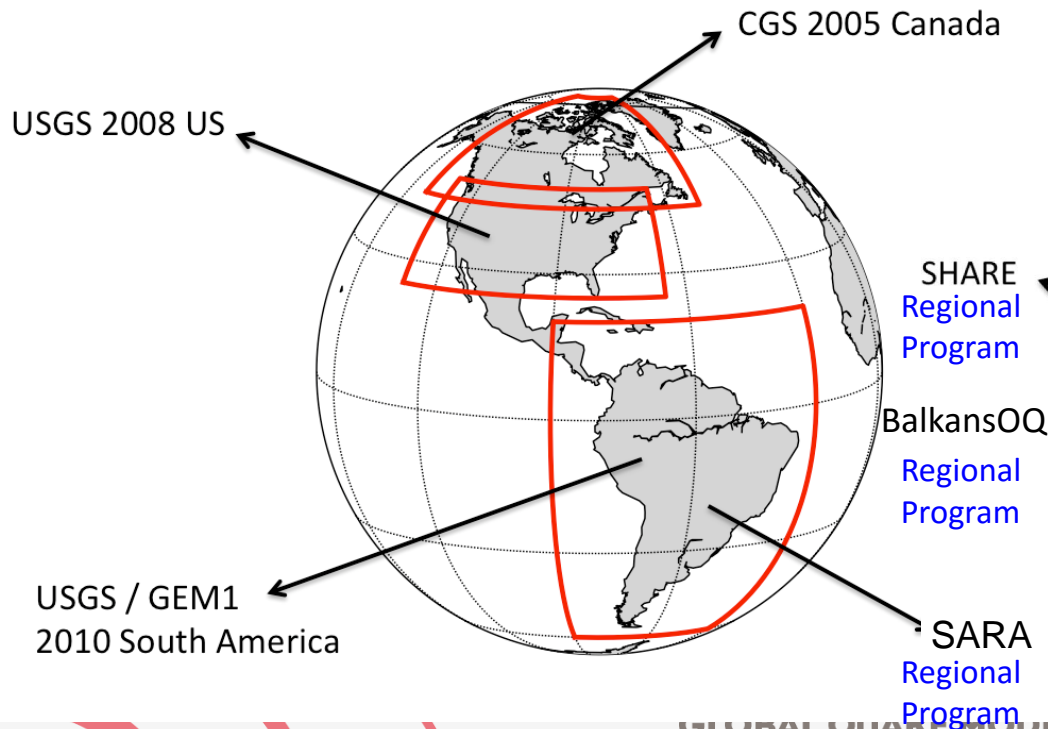
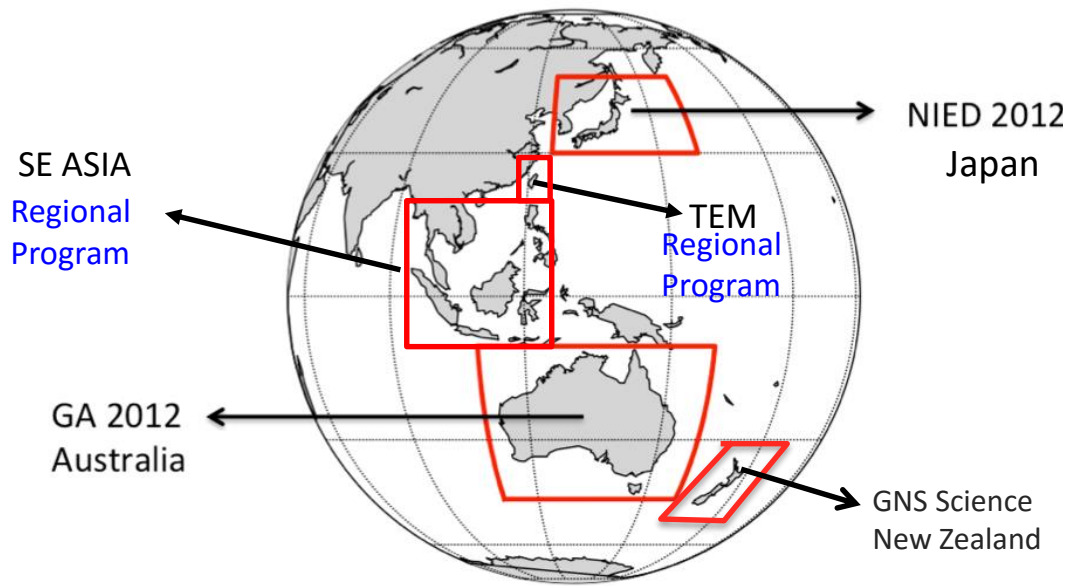
# GEM tools used to empower local experts



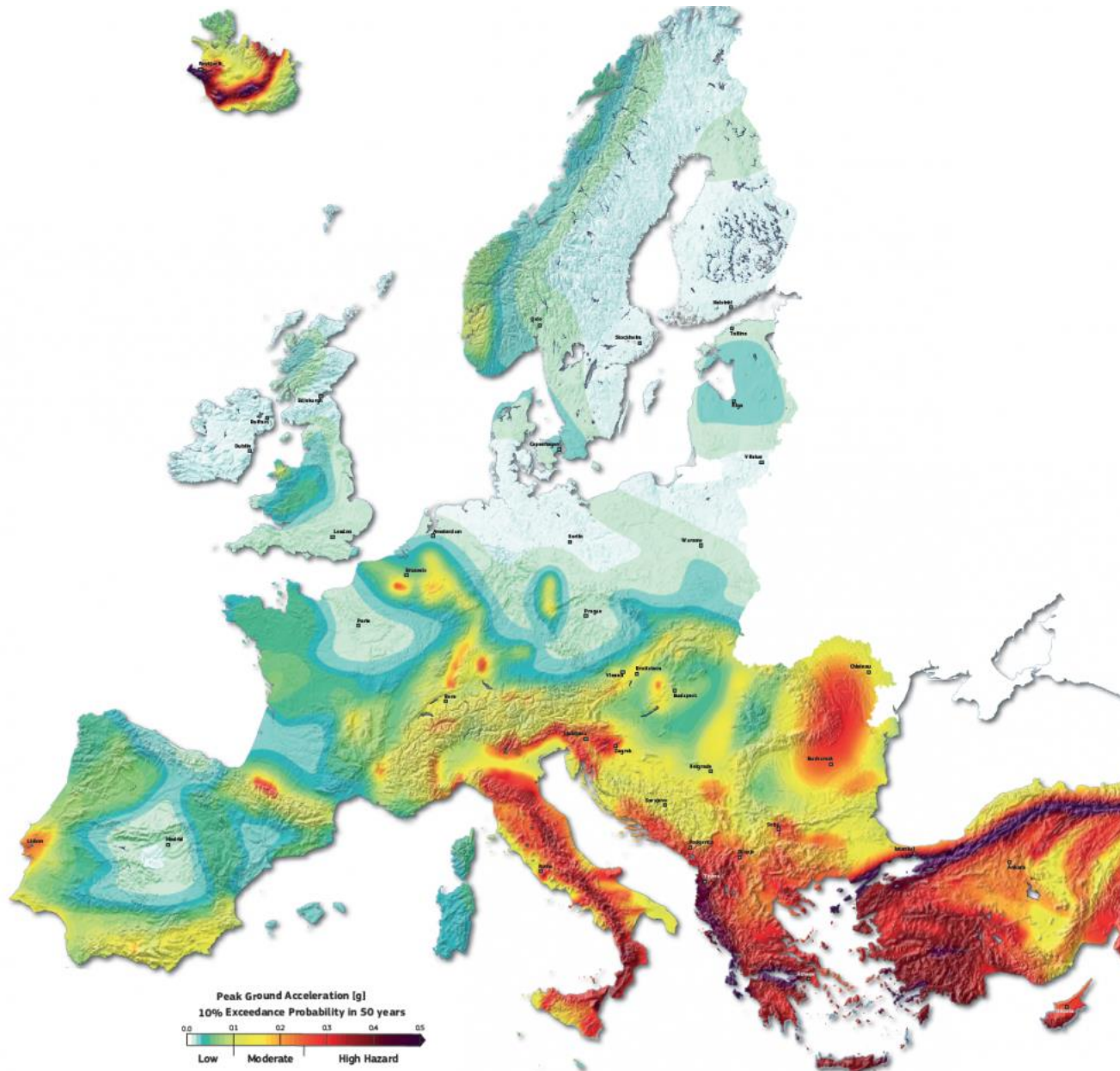
GEM-trained staff of CENEPRED coordinate preparation of Lima's exposure model

# Model implementations and regional programs

A growing repository of models. Global coverage expected to be completed by 2018



# OpenQuake used to understand risk worldwide



## Regional Models

Central Asia (EMCA)  
East African Rift (SSAHARA)  
Europe (SHARE)  
Middle East (EMME)  
South America (SARA)

## National Models

Australia  
Canada  
Colombia  
Ecuador  
Italy  
Indonesia  
New Zealand  
Papua New Guinea  
Switzerland  
Taiwan  
Tunisia  
Turkey

Seismic Hazard Harmonization for Europe — SHARE Project

# Working together to understand risk



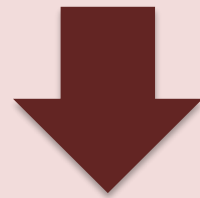
# Capacity development

41 countries have been involved in training in seismic risk assessment.



# Increased GEM's Value Proposition

**GEM** increasingly complete and  
valuable



**A world that is resilient to earthquakes!**

VALOR COMERCIAL [MILL. COP]			
222524 - 1000000	6500001 - 7500000		
1000001 - 2250000	7500001 - 10000000		

# Urban Risk Assessment at GEM

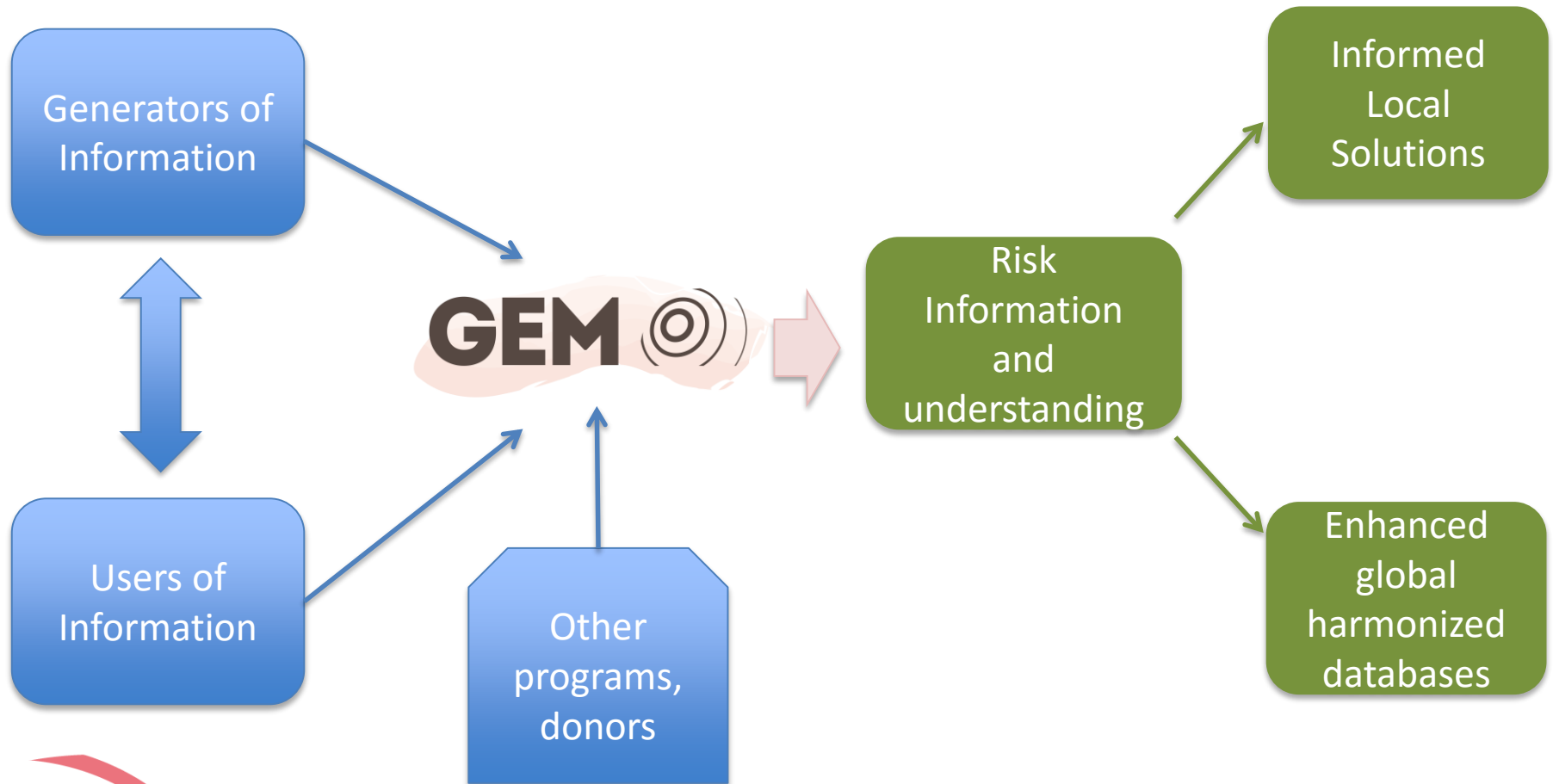
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working together  
to assess risk

# Typical components of a GEM Project

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# Urban Resilience Workshop for Yangon – 16-17 March, 2016



More than 50 participants from community, Government, NGO's, academy

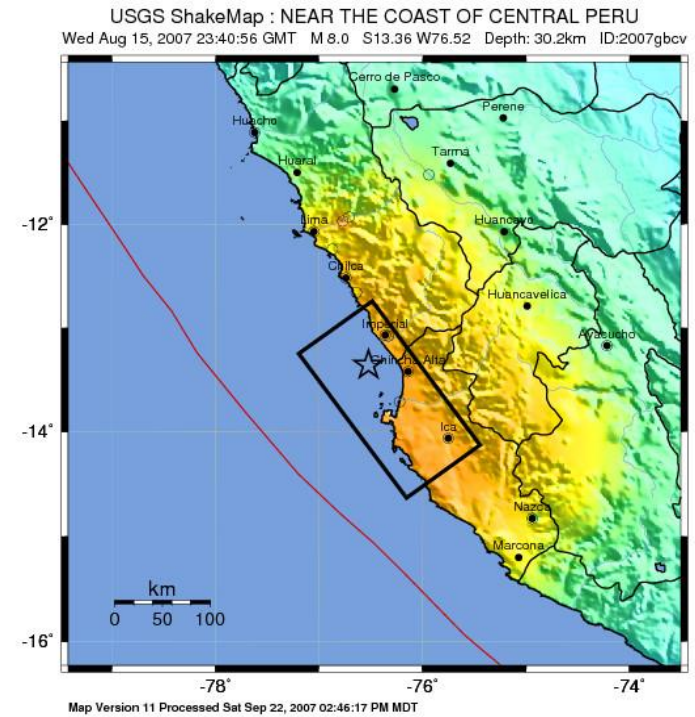
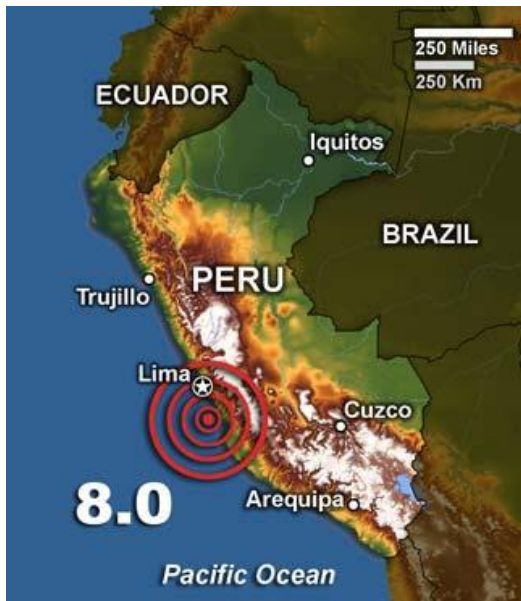
- Assess the current resilience level of Yangon
- Identify gaps, needs, and priorities
- Agree on long-term resilience goals



# Risk assessment for Peru

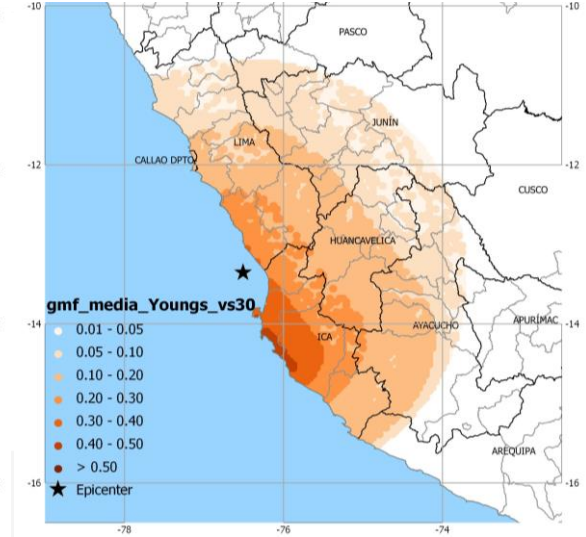
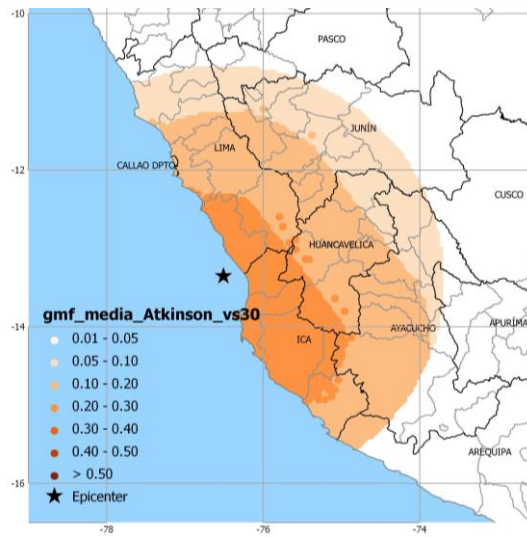
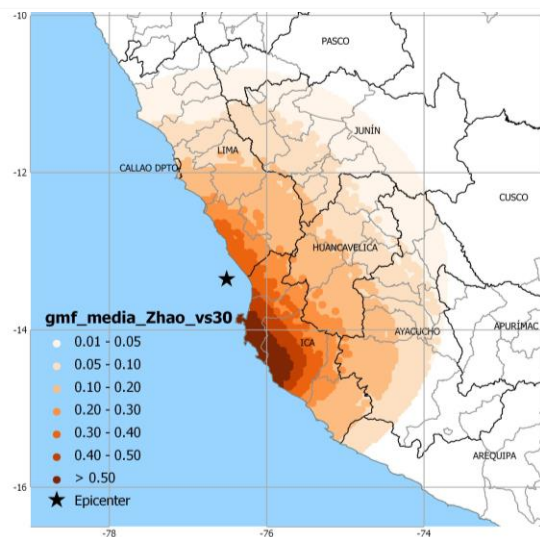
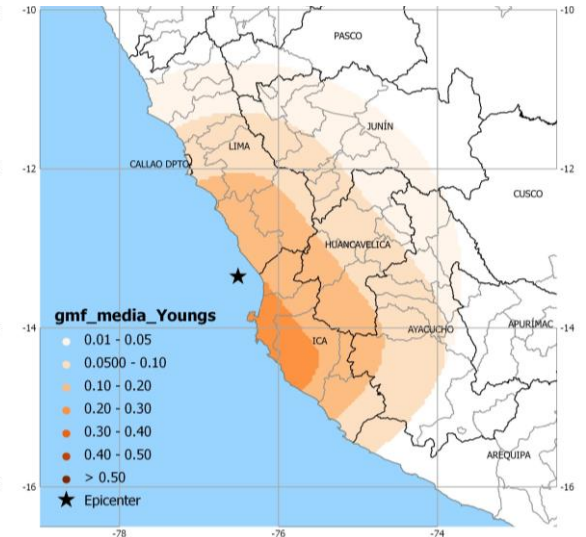
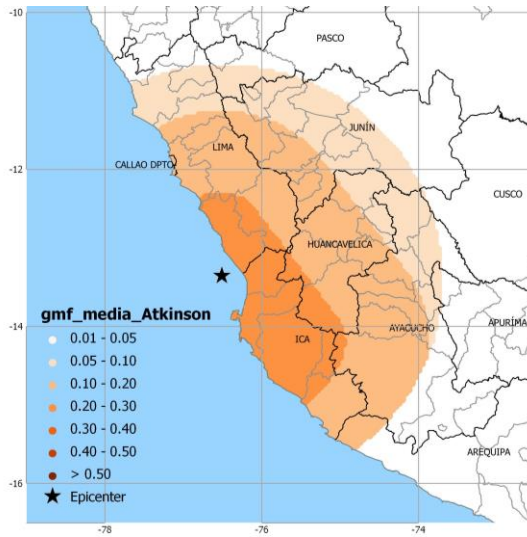
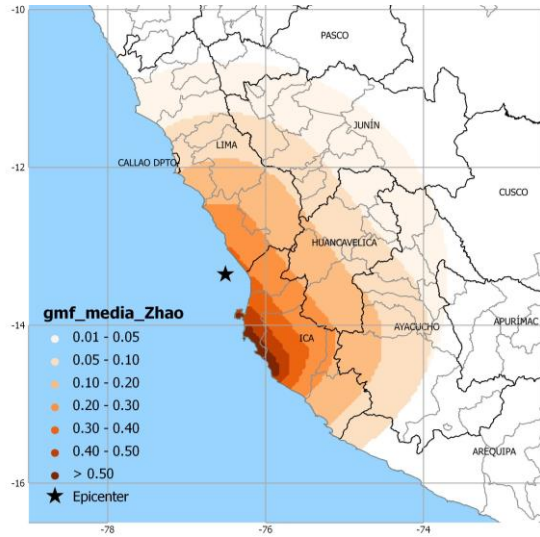
## Testing the model for an Earthquake Scenario:

### PISCO 2007 (M<sub>w</sub>8.0)

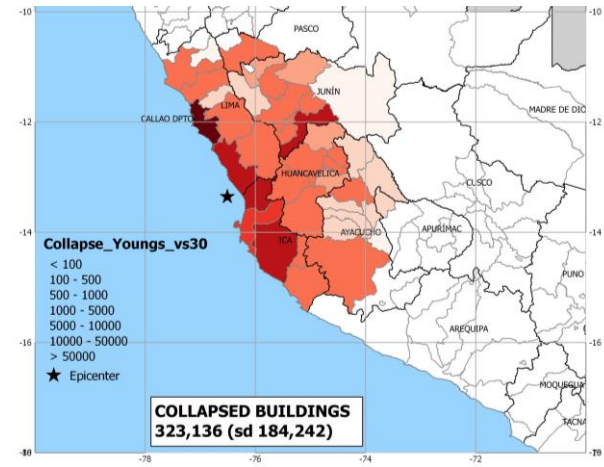
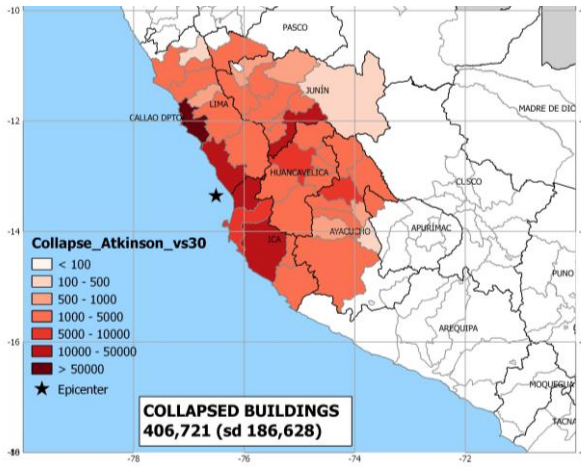
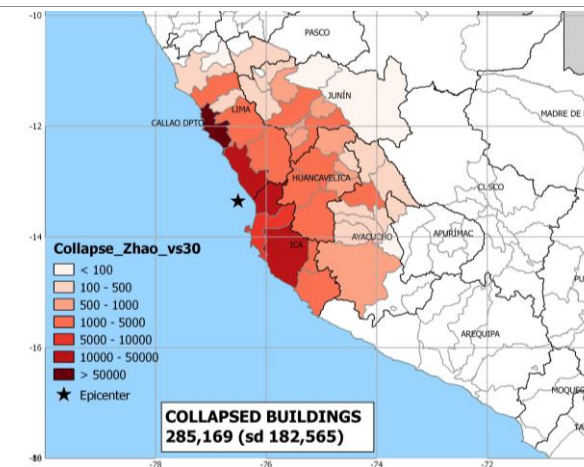
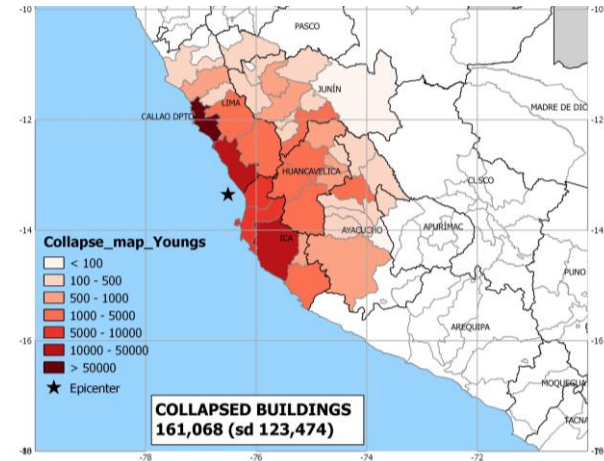
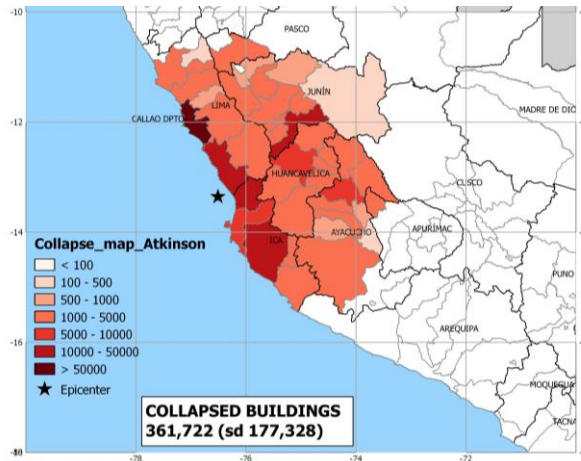
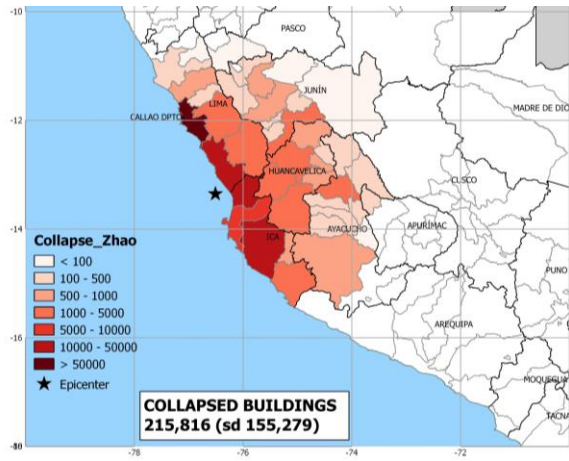


PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
POTENTIAL DAMAGE Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
ESTIMATED INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

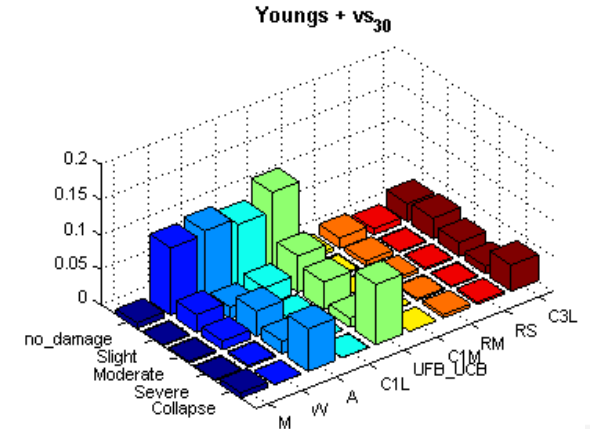
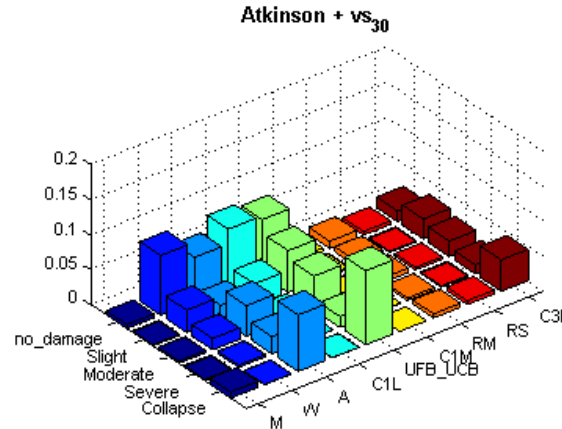
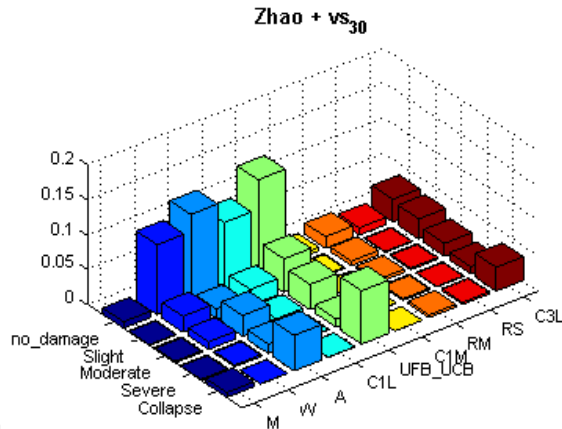
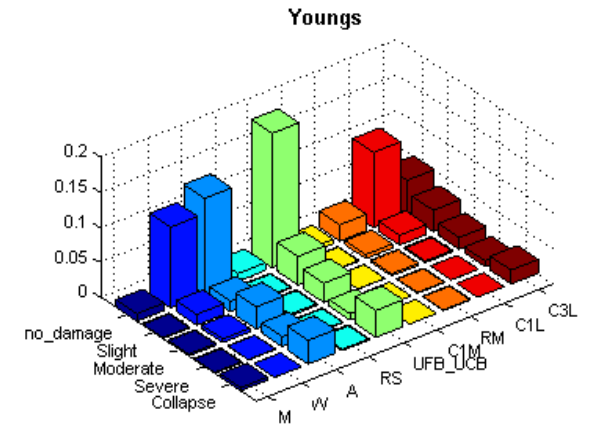
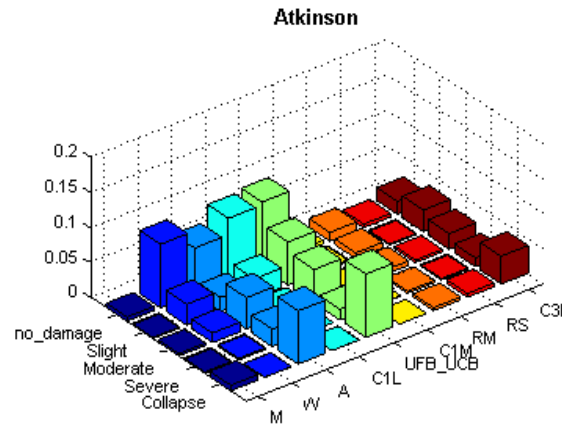
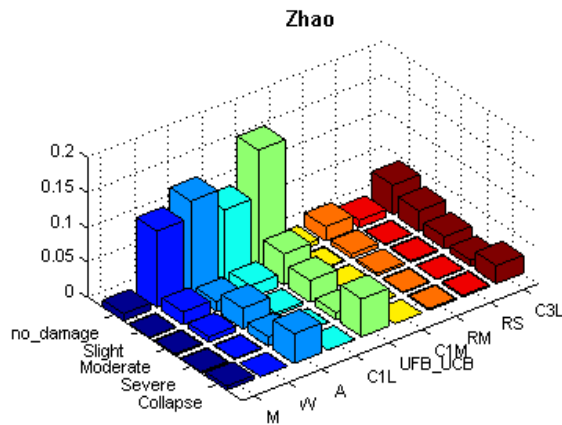
# Hazard Analysis



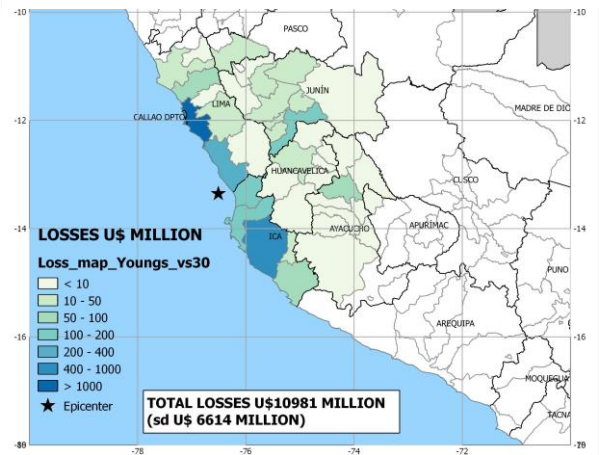
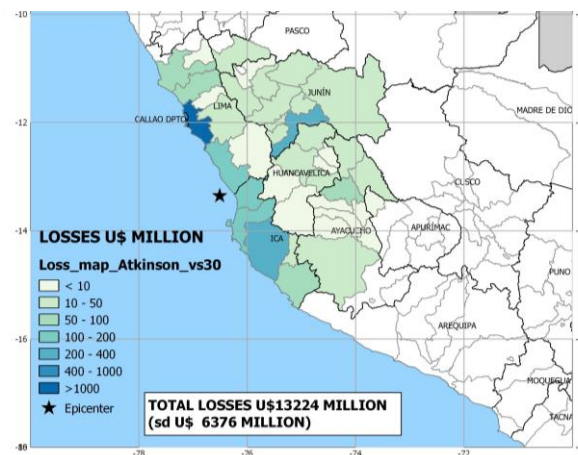
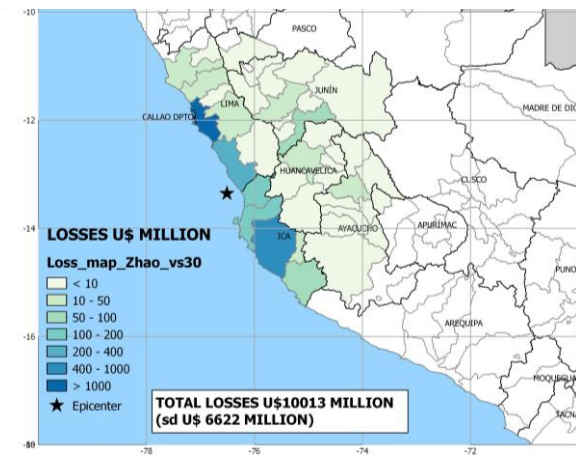
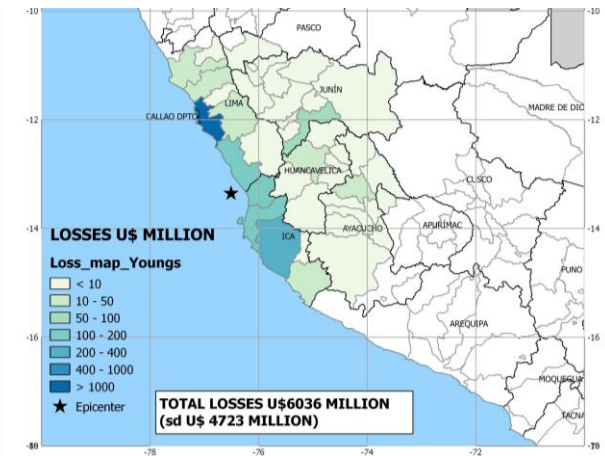
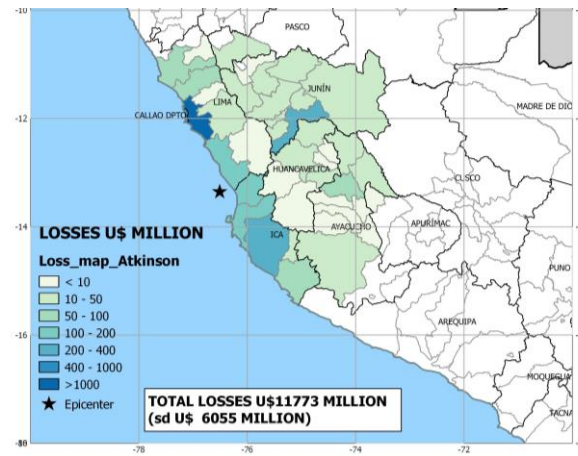
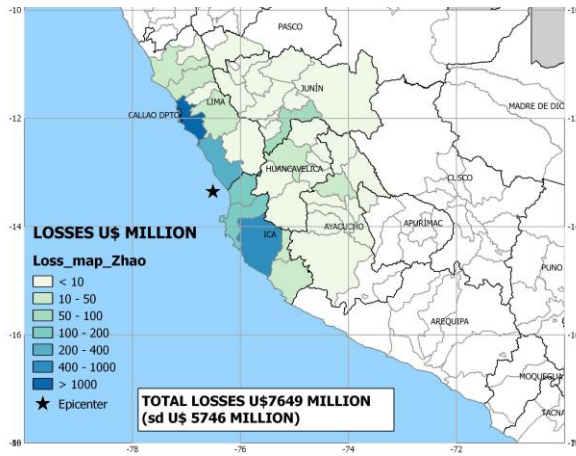
# Estimation of building collapse



# Distribution of damage per building typology



# Loss estimates



# Damage and Loss Estimation



**Building collapse estimated using OpenQuake for Tyre, Lebanon**

# Pre-Disaster Shelter Planning

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working together  
to assess risk

# Pre-Disaster Planning – Necessary information

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- How many killed people are expected?
- How many injured people are expected?
- How many hospital beds are available?
- How many displaced people are expected?
- What are the most affected areas?
- Where are the safer areas?
- How many shelter-buildings are available?

# Risk Mapping for Strategic Planning of Shelter Response in Tijuana, Baja California, México

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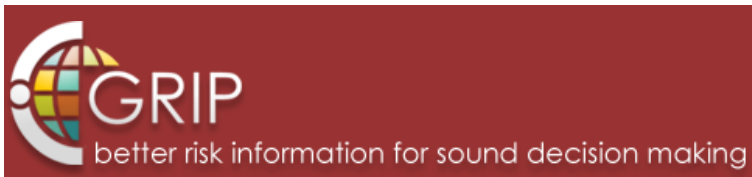


**H. AYUNTAMIENTO  
TIJUANA B.C.**

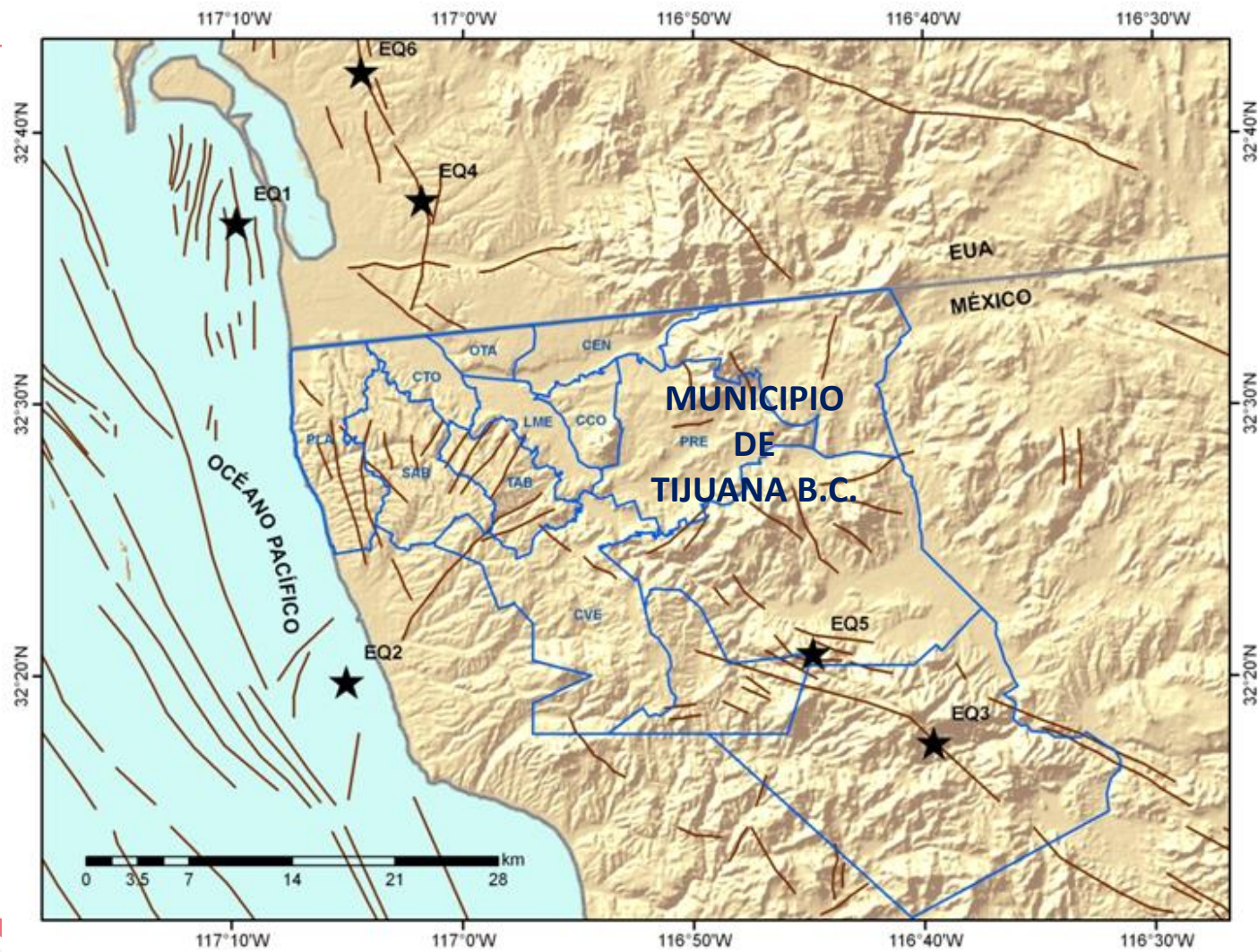
**Antonio Rosquillas and Luis Moreno**  
Municipio de Tijuana



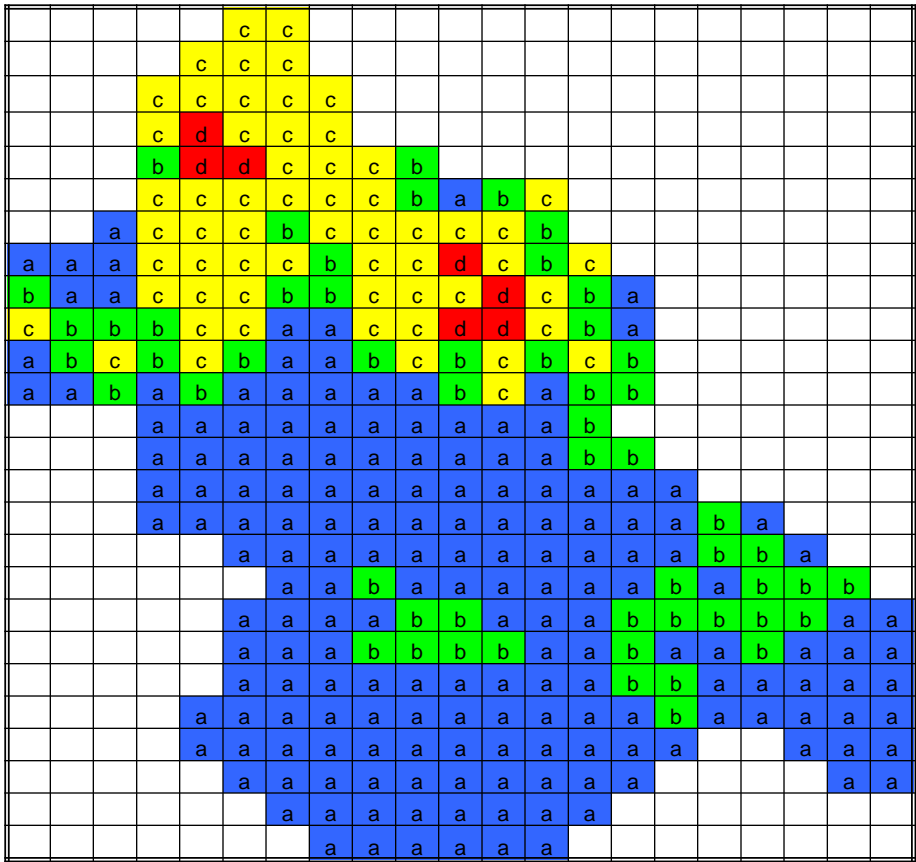
**CENTRO DE INVESTIGACIÓN  
CIENTÍFICA Y DE EDUCACIÓN  
SUPERIOR DE ENSENADA.**



**International Federation  
of Red Cross and Red Crescent Societies**



# Estimated building damage distribution



Color ID	Automatic Range		Manual Range	
	From	To	From	To
a	0	18	0	18
b	18	35	18	35
c	35	53	35	53
d	53	70	53	70



## Summary of shelter needs

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	SAB	CEN	CTO	CCO	CVE	LME	PRE	OTA	PLA	TAB	Total
<b>EQ1</b>	10,000	4,622	8,917	3,282	1,226	5,839	7,276	4,497	6,372	6,246	<b>58,277</b>
<b>EQ2</b>	12,392	4,593	6,853	3,661	3,184	7,012	8,576	3,341	5,335	9,503	<b>64,449</b>
<b>EQ3</b>	3,025	2,792	1,942	2,400	1,360	2,751	8,457	1,266	947	3,648	<b>28,588</b>
<b>EQ4</b>	12,465	10,140	11,085	6,676	1,703	9,942	15,133	7,984	6,019	10,169	<b>91,316</b>
<b>EQ5</b>	4,986	4,504	2,900	4,289	2,581	5,317	16,561	1,993	1,456	6,338	<b>50,925</b>
<b>EQ6</b>	6,411	6,063	5,761	3,581	1,032	4,979	8,437	3,985	3,216	4,979	<b>48,444</b>

Number of persons with shelter needs estimated  
for the six earthquake scenarios

## Participant organizations

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- Municipal government
- State government
- Federal government
- National Defense Secretary.
- Marine Secretary
- Red Cross
- Volunteers
- International Humanitarian Institutions

MORELOS PARK (open space) Area = 560 000 m<sup>2</sup> Shelter for 1000 people  
(42m<sup>2</sup>/person)



GOLF COURSE (open space) Area = 429 203 m<sup>2</sup> Shelter for 10 000 people (private)



AIRPORT (open space) Area = 593 234 m<sup>2</sup> External supplies reception

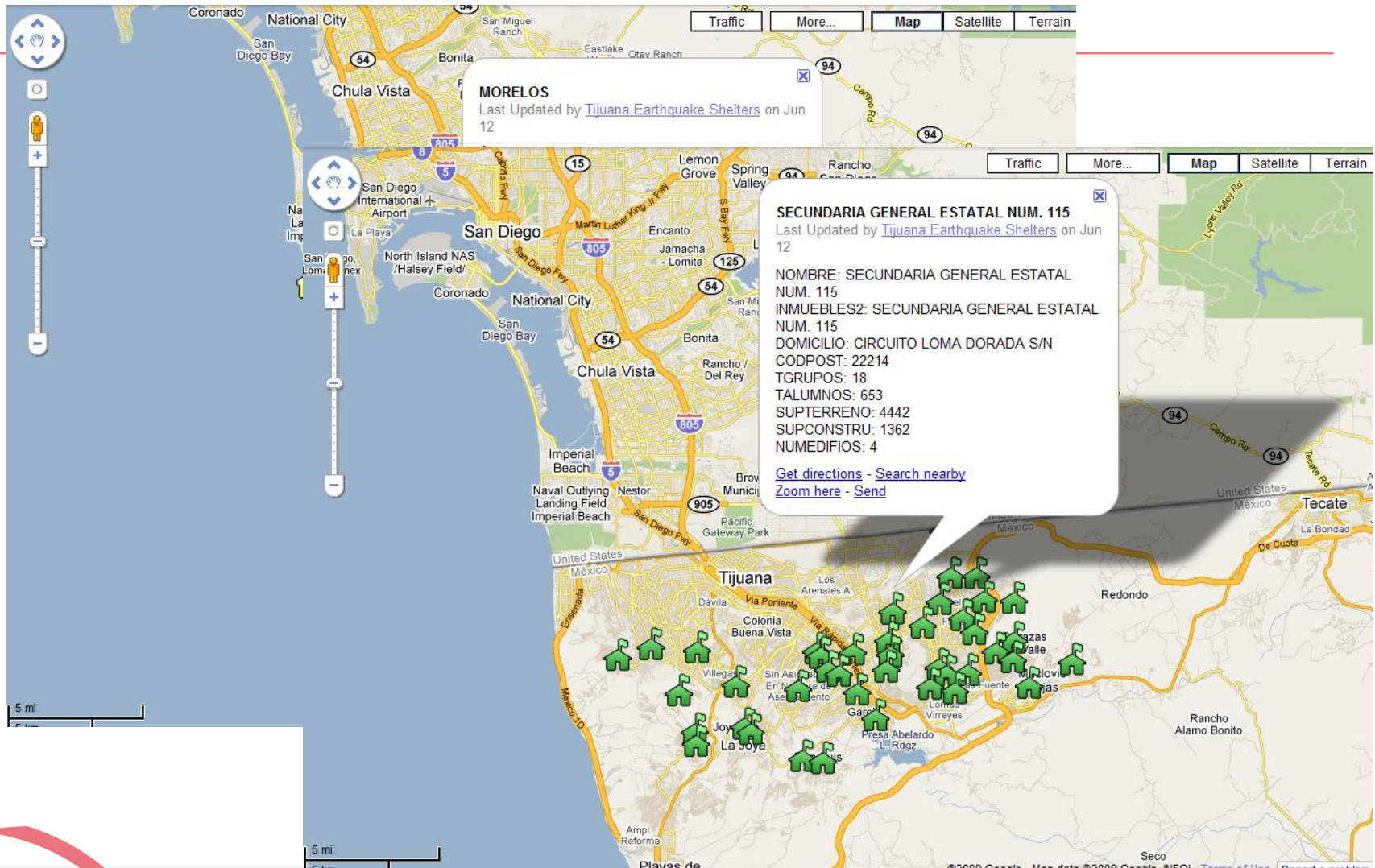


SPORT FIELDS Area = 358 115 m<sup>2</sup> Shelter for foreign teams (near airport)

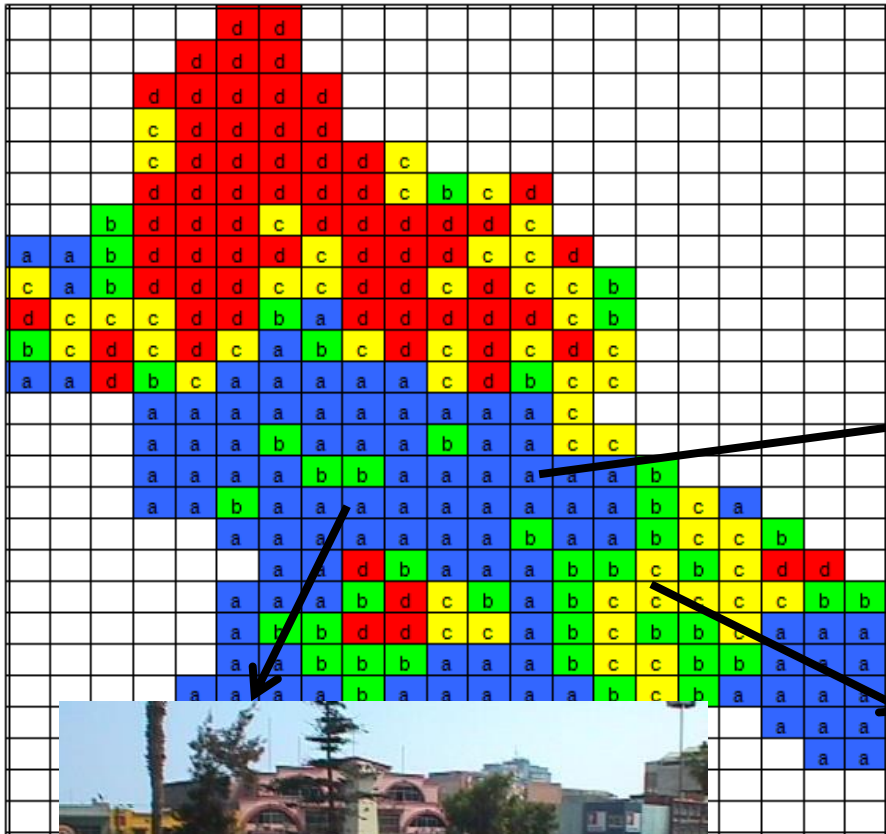


# MILITARY FIELD Area = 1 135 277 m<sup>2</sup> Supplies





18 – September – 2009



# Thank you!

[www.globalquakemodel.org](http://www.globalquakemodel.org)

<http://platform.openquake.org>



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