High-Level Roundtable
on the Financial Management of Earthquakes

OECD Headquarters, 2 rue André Pascal, 75116 Paris

GLOBAL EARTHQUAKE MODEL
CALCULATING AND COMMUNICATING SEISMIC RISK WORLDWIDE

Rui Pinho
GEM Foundation
Global Earthquake Model

Calculating and communicating seismic risk worldwide

Rui Pinho | Secretary General, GEM Foundation

THE GLOBAL EARTHQUAKE MODEL (GEM)

“A collaborative effort devised and launched by OECD’s Global Science Forum, aimed at engaging the global community in the design, development and deployment of uniform open standards and tools for earthquake risk assessment worldwide”
PUBLIC-PRIVATE PARTNERSHIP

10 countries have adhered so far

7 private organisations have partnered up with GEM so far

they contribute 13.6 M Euro

discussions and negotiations are ongoing with 15+ others

the OECD, World Bank, UNESCO, UN/ISDR, IAEE and IASPEI are associate participants

PRIVATE PARTICIPANTS

Founders:

- Munich RE: 5 Mill. €
- ZURICH: 3 Mill. €
- AIR WORLDWIDE: 1 Mill. €
- Willis: 1 Mill. €
- EUCENTRE: 1.6 Mill. €

Sponsors:

- FM Global: 1 Mill. €
- Hannover Re: 1 Mill. €
Pilot project to generate GEM’s first products and develop GEM’s initial infrastructure

**GLOBAL COMPONENTS**

For and from the community..

- **scientific modules** of GEM that are developed at a global scale to provide standards, methods and tools for global datasets
- addressed by **international consortia** that respond to Requests for Proposals (RfPs) released periodically by the Scientific Board
- before consortia are selected there is a thorough process of **expert elicitation, community feedback, and peer review**
- provide the **global framework** for the model which will be reviewed and further developed by the Regional Programmes to ensure they are adequate for regional needs and characteristics
HAZARD GLOBAL COMPONENTS

- Expert elicitation, 5 Request for Proposals (RfP) drafting and publication
- International consortia submitted 9 proposals (20+ Institutions)
- 14 peer reviewers, Scientific Board selection, Governing Board decision.

Global Earthquake History
Global Instrumental Earthquake Catalogue
Global Active Fault and Seismic Source Database
Global Ground-Motion Prediction Equations
Global Geodetic Strain Rate Model

RISK GLOBAL COMPONENTS

- Expert elicitation, 5 Requests for Proposals (RfP) drafting, community feedback, RfP review and publication
- International consortia submitted 14 proposals (60+ Institutions)
- 20 peer reviewers, Scientific Board selection, Governing Board decision.

GEM Ontology and Taxonomy
Global Exposure Database
Global Earthquake Consequences Database
Global Vulnerability Estimation Methods
Inventory Data Capture Tools
SOCIO-ECONOMIC IMPACT GLOBAL COMPONENT

- Expert elicitation, 7 workshops and meetings, 1 Request for Proposal (RfP) drafting, community feedback, RfP review and publication
- International consortia submitted 3 proposals (20+ institutions)
- 7 peer reviewers, Scientific Board selection, Governing Board decision.

REGIONAL PROGRAMMES

Feeding and feedbacking global models..

SHARE, NERA, Syner-G, EMME, EMCA

GEM Regional Workshops
Regular regional workshops to aid regional and global coordination, typically featuring:

- Discussion of status-quo of regional activities in seismic risk, identifying gaps in knowledge and data
- Presentation of global activities, databases, methods, standards
- Sessions dedicated to technology transfer (software and tools)
TECHNICAL ADVISORY POOL

Working Group Meetings

GLOBAL INVOLVEMENT

North America
Caribbean
Central America
South America
Europe
Africa
Middle East
South Asia
North East Asia
South East Asia and Pacific
FIRST PRODUCTS

What is OpenQuake?

OpenQuake is an open source software application that allows users to compute seismic hazard and risk on any scale, developed as an open source project, available for download from http://openquake.org.

OPENQUAKE

Hazard curves

Curves that give the probability of exceedance of a certain intensity measure level, within a given time span.
**OPENQUAKE**

**Hazard maps**

Distribution of the expected ground motion for a certain probability of exceedance with a given time span.

**OPENQUAKE**

**Stochastic event sets and ground motion fields**

Set of events representing possible seismicity histories generated by the seismic sources contained in a model and their respective shaking field.
Ground motion fields for single events

Distribution of the ground motion in a region for a single earthquake

Deterministic scenario losses calculator

A calculator capable of computing the economic and human losses for a single earthquake scenario
**Loss curves**

Curves that give the probability of exceedance of a certain loss, within a given time span.

**Loss maps**

Distribution of the expected losses for a certain probability of exceedance with a given time span.
Seismic Hazard disaggregation

Disaggregation provides the contributions to the hazard of discrete combinations of basic parameters considered in the calculations (e.g. magnitude, rupture-site distance).

Uniform hazard spectra

Spectra where each ordinate has the same probability of being exceeded in a given investigation time.
Disaggregation of losses

Disaggregation provides the contributions to the losses of discrete combinations of basic parameters considered in the calculations (e.g., magnitude, rupture-site distance).

Cost-Benefit Calculator

\[ BCR = \frac{(EAL_C - EAL_R)(1 - e^{-rt})}{C} \]

The Benefit-Cost Calculator will allow users to ascertain whether retrofitting the building stock is economically beneficial.
USER INTERFACE FOR OPENQUAKE

OPENQUAKE COLLABORATIONS

Istituto di Geofisica, Ecuador
OPENQUAKE COLLABORATIONS

KOERI/EMME

OPENGEM

Performing calculations and producing output using OpenQuake and (tested) data/models/tools that are available in OpenGEM.

SCENARIO 1

Performing calculations and producing output, using OpenQuake, models/tools that are available in OpenGEM, but own (proprietary) data.

SCENARIO 3

Browsing through pre-calculated GEM outputs and interacting with the global GEM community

SCENARIO 2
TESTING AND EVALUATION

Scope of activities

Testing and Evaluation will include both "retrospective" and "prospective" tests:
- the former uses past data, and is required as an immediate activity for sanity checks and pre-evaluation whilst building the GEM model over the next few years;
- the latter includes the testing of the model against future events in a controlled environment.

Testing and Evaluation Facility being set up in GFZ, Potsdam.

BUILDING GLOBAL OPEN DATABASES

Crowdsourcing

"Crowdsourcing represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call." Jeff Howe, June 2006
RECAPping GEM

A comprehensive interactive model: Calculating and communicating hazard, risk (exposure and vulnerability) and impacts on the society and the economy

State-of-the-art: Latest developments in science and technology

Community based: Community involved in designing and implementing GEM procedures, software, tools, methods, collecting data etc.

Open access: Open source software, transparent tools and accessible global datasets

Global coverage: Global and regional coverage. Interaction with Regional Programmes

Serving Multitude of Users: Intuitive, customised interfaces and users needs assessments

Dynamic ("alive"): Updatable, modular, flexible models and tools

Public / Private Partnership: Combines strengths and objectives of public and private sectors

Application beyond GEM: Expandable to other perils

STAY UPDATED

GEM Website
- Most update source of information
- News, results, calls, …
- www.globalquakemodel.org

GEM Report 2009/2010 v2
- Available from website and hard-copy

GEM Brochure
- Available from website and hard-copy

Bi-monthly e-Newsletter
- Sign-up at website
HYOGO FRAMEWORK FOR ACTION & GEM

Aspects of “Priorities for Action” Addressed by GEM

**HFA1:** coordination of global and regional activities related to seismic risk, community participation and networking…

**HFA2:** advance knowledge of seismic hazard and vulnerability, produce hazard and risk maps and indicators and widely disseminate, develop and improve databases, promote open exchange of data and software, promote application of remote sensing, GIS, cost-benefit assessment, develop common methodologies for risk assessment…

**HFA3:** provide easily understandable information on seismic risk, improve dialogue between scientific communities and practitioners, offer training programmes, strengthen technical and scientific capacities…

**HFA4:** promote development of financial risk-sharing mechanisms, public-private initiative, promote financial instruments for addressing seismic risk, aid revision and development of building codes…

**HFA5:** coordinated regional programmes, working with earthquake risk mitigation programmes…