

# Improved Earthquake Risk Management for Governments

Consultation Day Event, 19 May 2013  
4<sup>th</sup> Global Platform for Disaster Risk Reduction  
Geneva, Switzerland

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*Nicole Keller, Head, GEM Communications &  
International Relations*

*Chris Burton, Leader, GEM Social Vulnerability*



working together to assess risk



**GLOBAL EARTHQUAKE MODEL**

# Objectives of Session

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## Introduce you to the Global Earthquake Model

- Our goals and vision

- Who we are

- What we do

## Explore your earthquake (and other natural hazard) risk management needs

- How to become involved

- How to become a member or collaborator

- Answer your questions

# Goals

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**Providing tools and resources for transparent analysis of earthquake risk anywhere in the world...**

**...by bringing individuals and organisations together in a global collaborative effort to leverage science to benefit society.**

# Vision

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**To change the landscape of earthquake risk assessment, and support risk understanding and risk reduction**

# What does GEM support?

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→ *risk financing* 

→ *urban planning* 

→ *risk awareness* 

→ *advancing risk assessment  
& modeling (science)*



# GEM and DRR

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- ▶ Hyogo Framework for Action
  - Building an evidence base for DRR
  - Developing information and sharing knowledge
  - Supporting risk assessment – hazard, exposure, vulnerability
  - Building expertise
- ▶ Current and Future Directions
  - Building public-private partnerships
  - Providing and supporting open data and tools
  - Developing standards and guidelines
  - Developing basis for economic investments in DRR
  - Supporting assessment of DRR targets and measures

# Who is GEM?

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A great diversity of people and organisations from around the globe working together for improved earthquake risk assessment

# GEM in a nutshell

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**25+** public and private organisations sustaining the effort

**250+** leading experts developing global best practice

**10+** collaborations initiated for regional model, data and tool development

**80+** countries where users have tested the open-source software for transparent and state-of-the-art earthquake hazard and risk assessment; the OpenQuake Engine

**10+** global uniform datasets on hazard, exposure and vulnerability becoming publicly available

**10+** training and technology transfer activities carried out worldwide

**2014** release of the comprehensive OpenQuake Platform for collaborative risk assessment

# The framework that defines our focus

GEM is about  
**integrated**  
**evaluation of**  
**earthquake risk**  
**worldwide**



We go all the way  
 from the probability  
 of earthquakes  
 happening to  
 including the socio-  
 economic  
 vulnerability of  
 societies

## Integrated Seismic Risk



### Physical Seismic Risk

Probability of damage and loss to  
 people and structures due to  
 earthquakes

### Socio-Economic Vulnerability and Resilience

Vulnerability of society and economy  
 and their capacity to cope with  
 earthquake events



#### Seismic Hazard

Probability of ground  
 shaking due to  
 earthquakes

#### Exposure

Elements at risk

#### Physical Vulnerability

Vulnerability of structures  
 and their occupants to  
 seismic hazard

# A public-private partnership

The non-profit and independent GEM Foundation is the legal entity driving the effort.

The foundation is funded and governed through a unique public-private partnership



# Current Public Participants

## Australia



Australian Government  
Geoscience Australia

## Chile



## Ecuador



## Germany



## Italy



## Japan



## New Zealand



Ministry of Business,  
Innovation & Employment

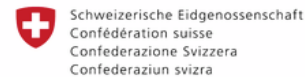
## Norway



## Singapore

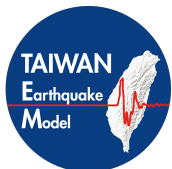


## Switzerland



## Taiwan

## Earthquake Model



## Turkey



## United Kingdom



## United States



# Current Private Participants

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## Founders:



## Sponsors:



# Current Associate Participants

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**OECD**

Organization for Economic Cooperation and Development



**WORLD BANK**

The World Bank



**UN-ISDR**

United Nations International Strategy for Disaster Risk Reduction



**UNESCO**

United Nations Educational, Scientific and Cultural Organization



**IASPEI**

International Association of Seismology and Physics of the Earth's Interior



**IAEE**

International Association of Earthquake Engineering



**CSSC**

California Seismic Safety Commission



**ICSU/IRDR**

International Council for Science /  
Integrated Research for Disaster Risk



**GOVERNING BOARD**

**SCIENTIFIC BOARD**



**MODEL FACILITY**



**OPENQUAKE PLATFORM**



**OPENQUAKE ENGINE**

- > DATA
- > TOOLS
- > BEST PRACTICE



**GEM SECRETARIAT**



**GEM GLOBAL BASIC DATASETS, MODELS AND TOOLS**



**STAKEHOLDER / EXPERT COMMUNITY**

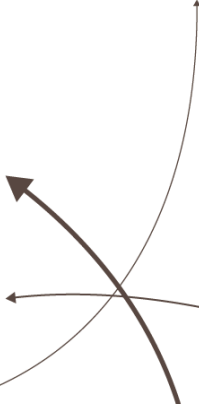
**TESTING & EVALUATION FACILITY**



**REGIONAL PROGRAMMES**



**GLOBAL COMPONENTS**



# Our main activities

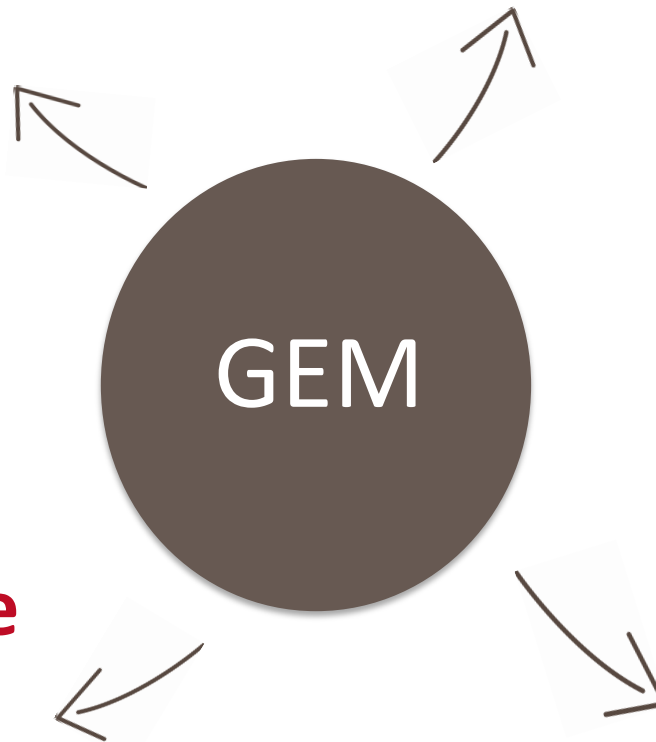
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**(1) global data,  
methods,  
guidelines &  
tools**

**(2) regional  
partnerships and  
collaboration**

**(4) open-source  
platform and  
software tools**

**(3) knowledge  
sharing and  
technology  
transfer**



# (1) Global guidelines, datasets and tools

Databases designed and initially compiled by international experts through global projects, and to be further developed through regional partnerships and collaborative projects.

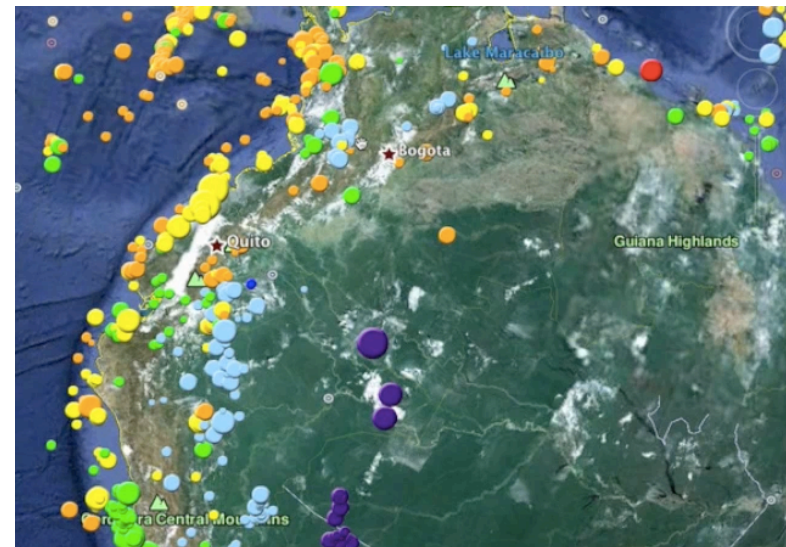
- Instrumental catalogue
- Historical Catalogue
- Geodetic strain rate model
- Active faults data
- Tectonic regionalisation model
- Building and population models (exposure database)
- Earthquake consequences data
- Physical vulnerability functions
- Socio-economic vulnerability and resilience indicators

# (1) Global guidelines, datasets and tools

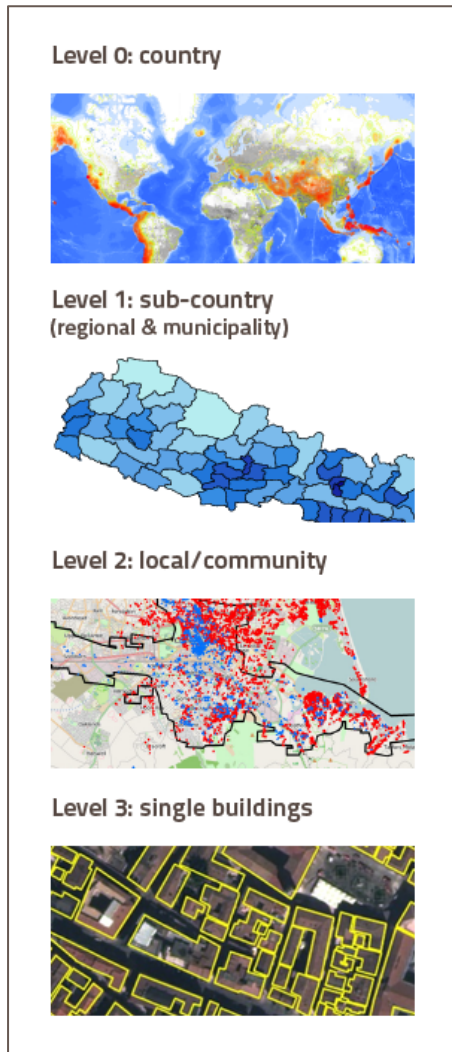
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## Example: Global Instrumental Earthquake Catalogue

- ▶ Released at the end of January 2013
- ▶ 110 years of seismic history featuring 20.000 + events
- ▶ Truly instrumental; the main earthquake have been re-calculated based on the basic seismogram readings of quality seismic stations worldwide.
- ▶ Homogenous to a high degree
- ▶ Includes uncertainty estimation
- ▶ References to original sources
- ▶ Reference for regional catalogues



# (1) Global guidelines, datasets and tools



## Example: Global Exposure Database

Large dataset of (the distribution of) buildings, building types and costs of buildings, and population worldwide

↙ multi-scale

↙ multi-stakeholder

↙ multi-disciplinary

↙ multi-use

...and (potentially) multi-hazard

# (2) Regional Collaboration

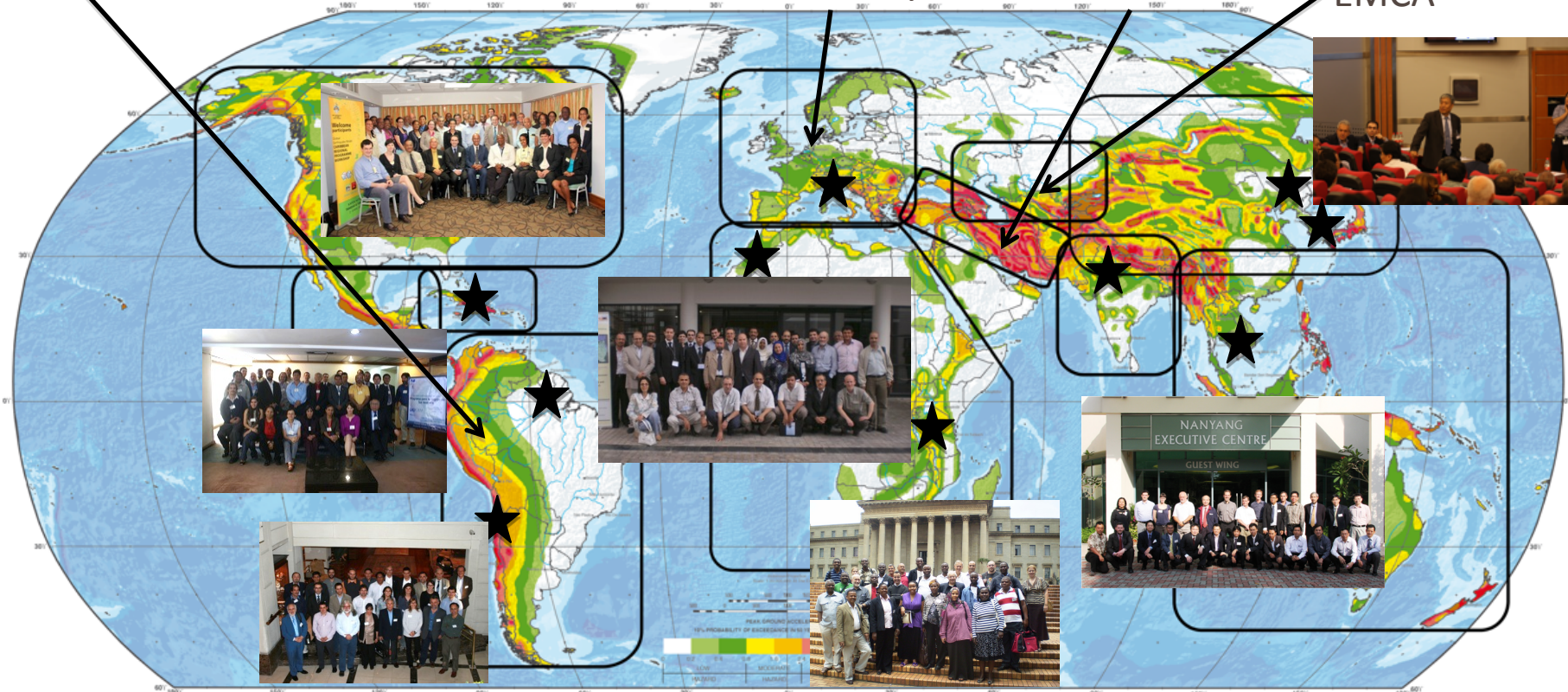
SARA



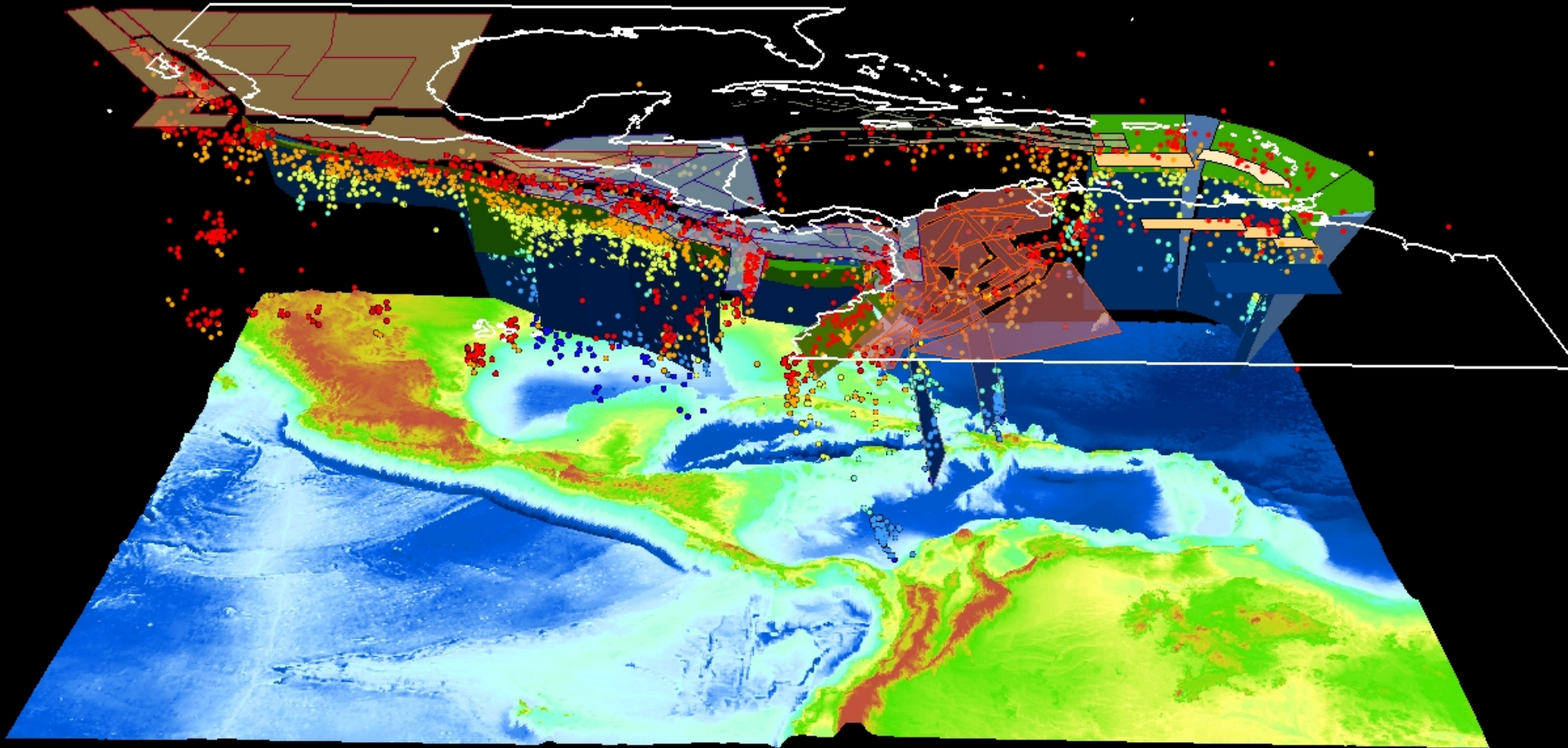
SHARE, NERA, Syner-G

EMME

EMCA



★ regional workshops



## (2) Regional Collaboration

Self-initiated collaborative projects: the project to harmonize hazard across the Americas

## (3) Technology transfer



- ▶ Training and facilitating use of open-source advanced modeling worldwide with the OpenQuake Engine (Central Asia, South Africa, Nepal, South-East Asia, now Balkan scientists)
- ▶ Training and facilitating use of other tools; such as in Bangkok the Active Fault Capture Tool for geologists

# (3) Knowledge sharing



- ▶ International meetings and discussions
- ▶ Apps, resources and videos
- ▶ Sharing science and outcomes through **GEM Nexus**; GEM's online community and collaboration platform

## (4) Open-source software and platform

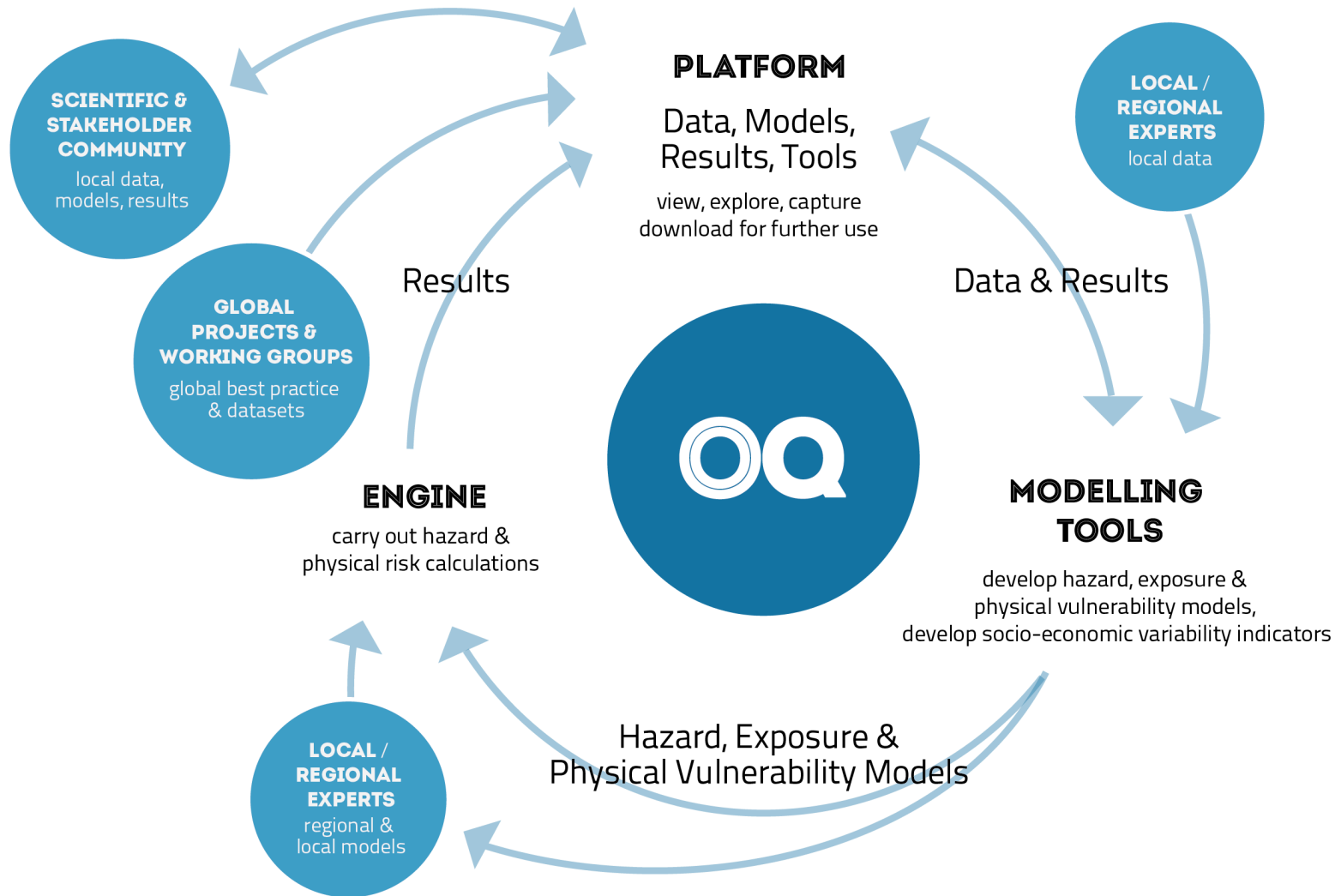
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**OpenQuake**: a web-based GIS platform that allows a user to..

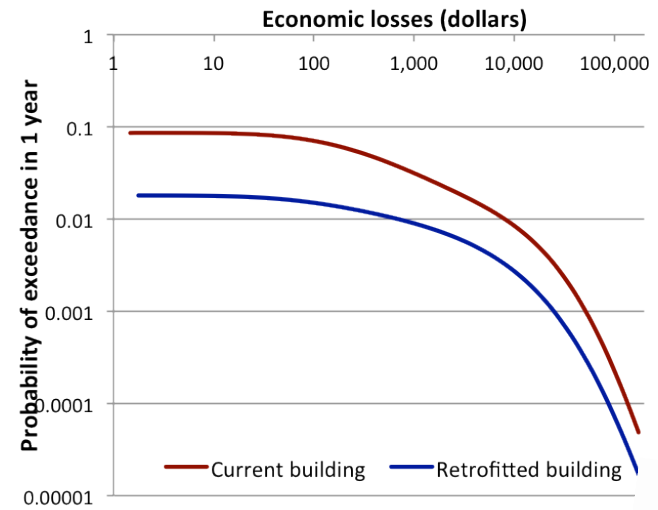
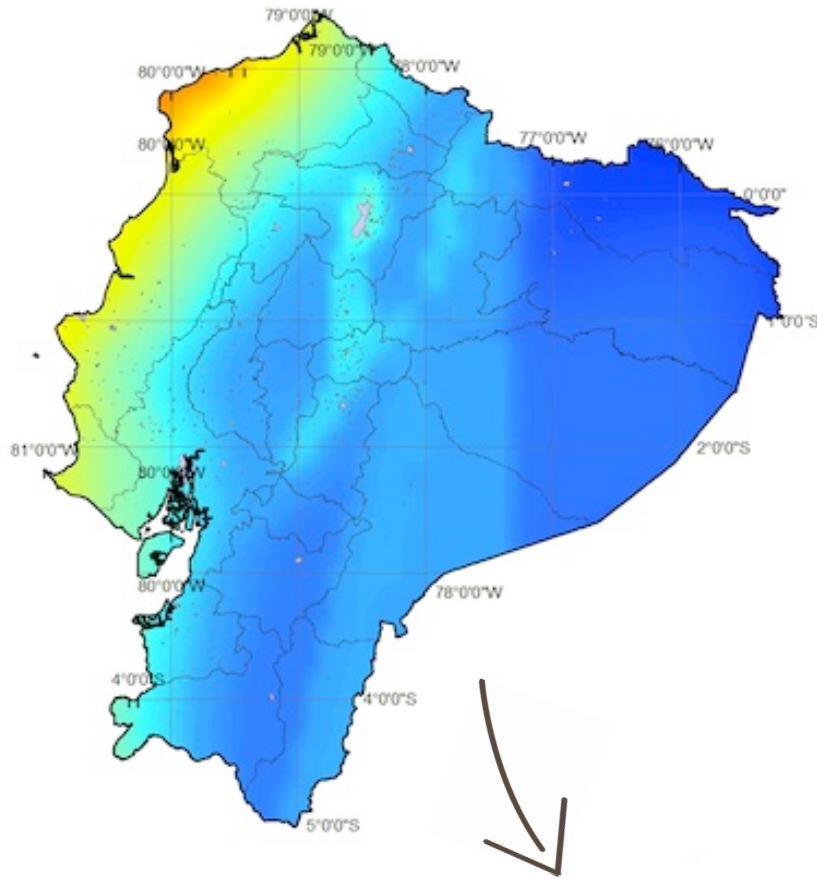
- ✓ **visualise, explore and manipulate** GEM's databases, models and results
- ✓ **access the engine** for running computationally intensive hazard and risk calculations
- ✓ **access and download desktop tools** for model development, use in the field, etc. etc.
- ✓ **contribute, share and discuss** data, new findings and results with the GEM community



# (4) Open-source software and platform



# (4b) The Engine

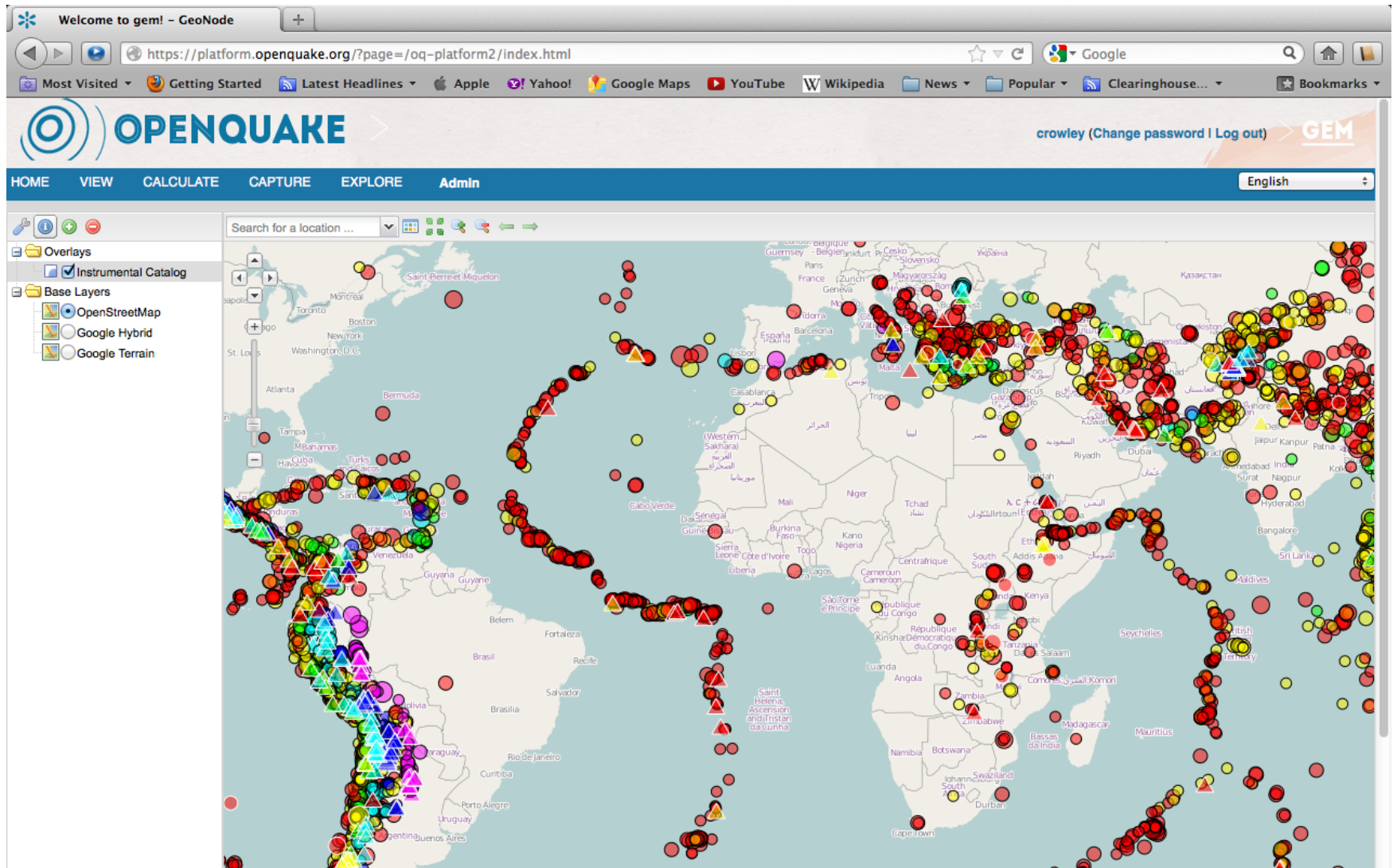


Cost-Benefit Analysis of retrofitting in Portugal

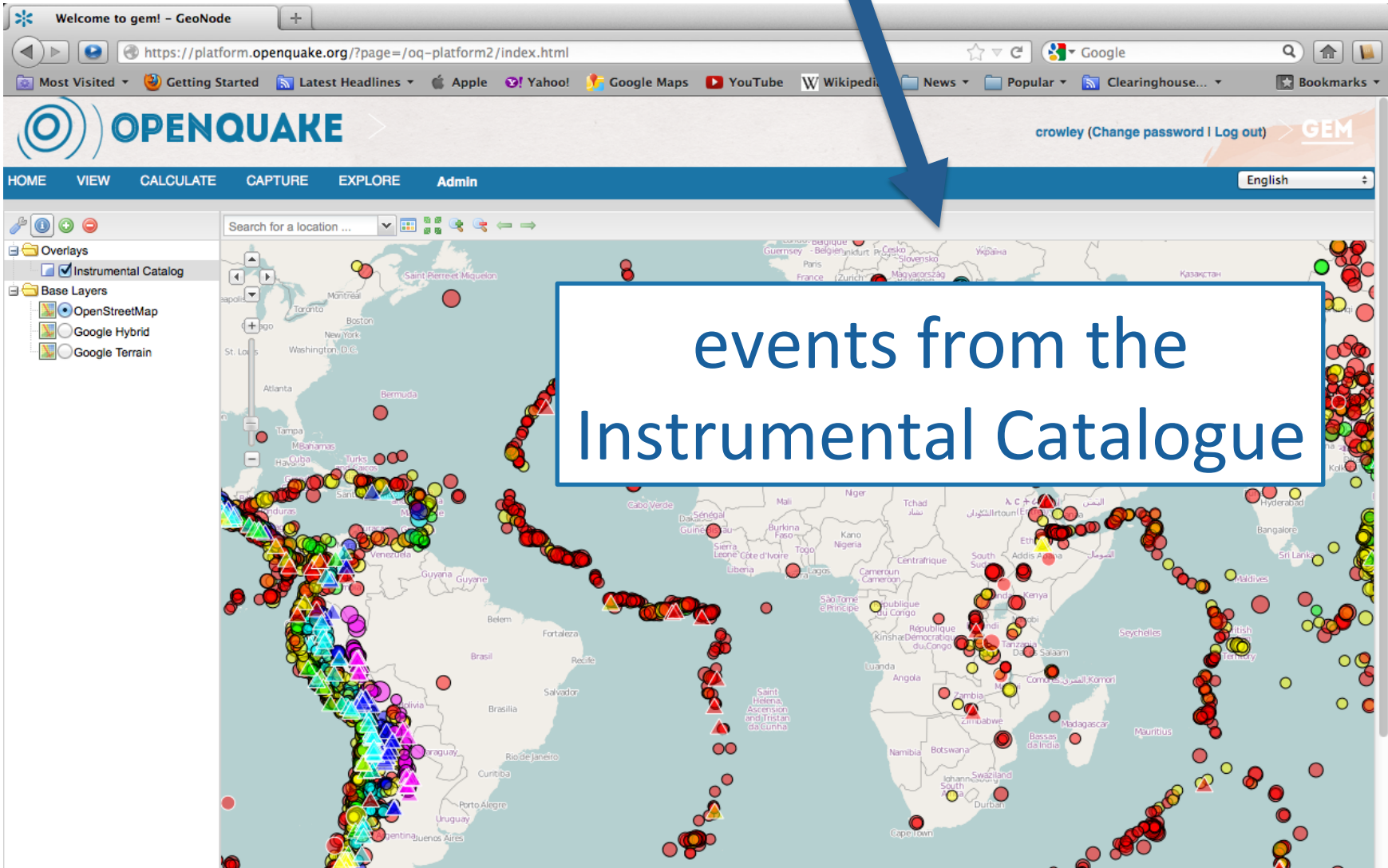
National Hazard Assessment in Ecuador

- 
- ▶ Over to Nicole

# VIEW global datasets



# VIEW global datasets



The image shows a screenshot of the OpenQuake platform interface. The browser address bar displays the URL <https://platform.openquake.org/?page=/oq-platform2/index.html>. The page header includes the OpenQuake logo, a user profile for 'crowley' with options to change password or log out, and the GEM logo. The navigation menu contains links for HOME, VIEW, CALCULATE, CAPTURE, EXPLORE, and Admin. A search bar is located above the map. The map itself is a world map with numerous colored circles and triangles representing earthquake events, primarily concentrated along the mid-ocean ridges and plate boundaries. A blue arrow points from the text 'VIEW global datasets' to the 'VIEW' link in the navigation menu. A white text box with a blue border is overlaid on the map, containing the text 'events from the Instrumental Catalogue'.

Welcome to gem! - GeoNode

https://platform.openquake.org/?page=/oq-platform2/index.html

OPENQUAKE

crowley (Change password | Log out) GEM

HOME VIEW CALCULATE CAPTURE EXPLORE Admin

English

Search for a location ...

Overlays

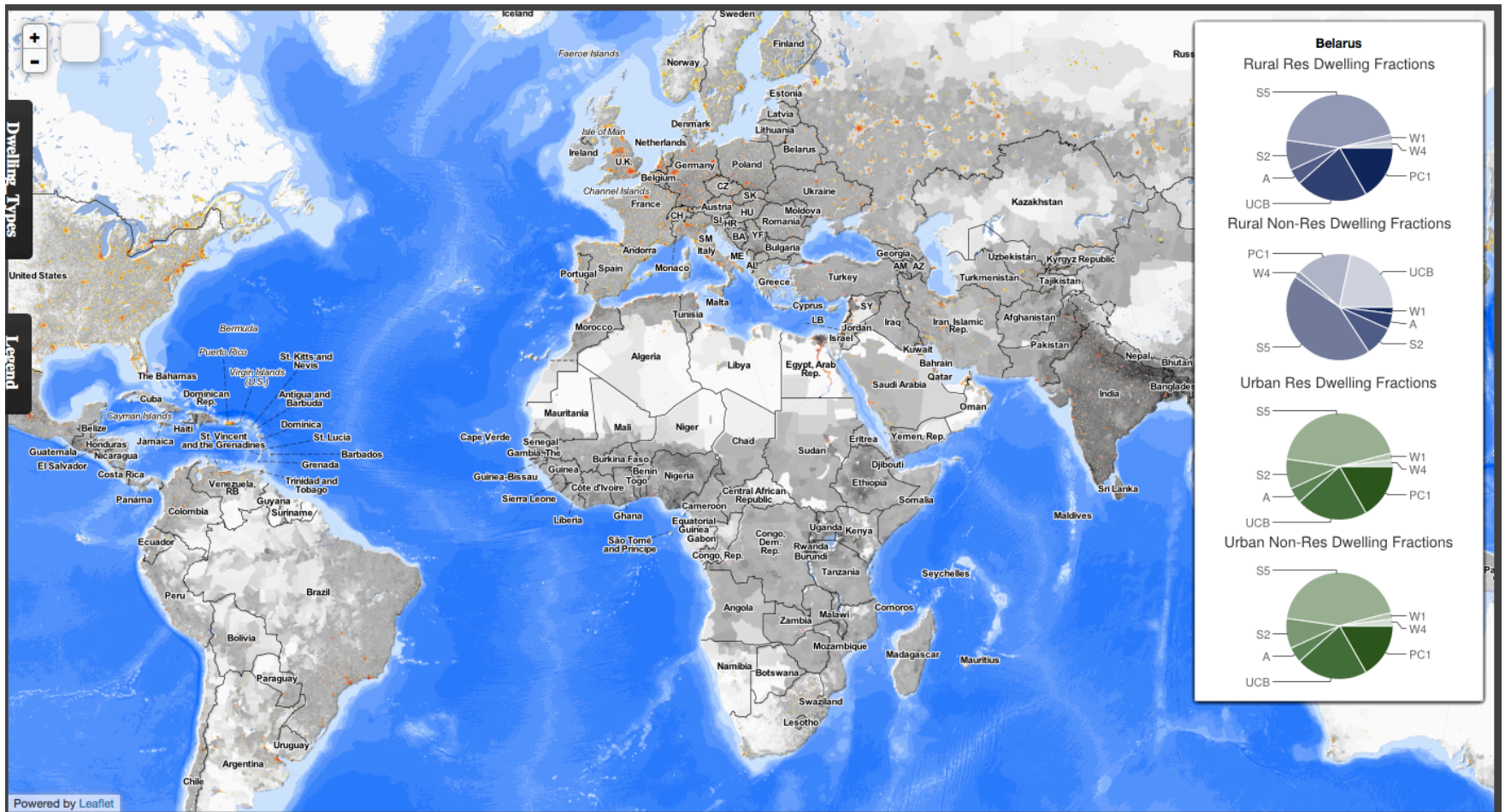
- Instrumental Catalog

Base Layers

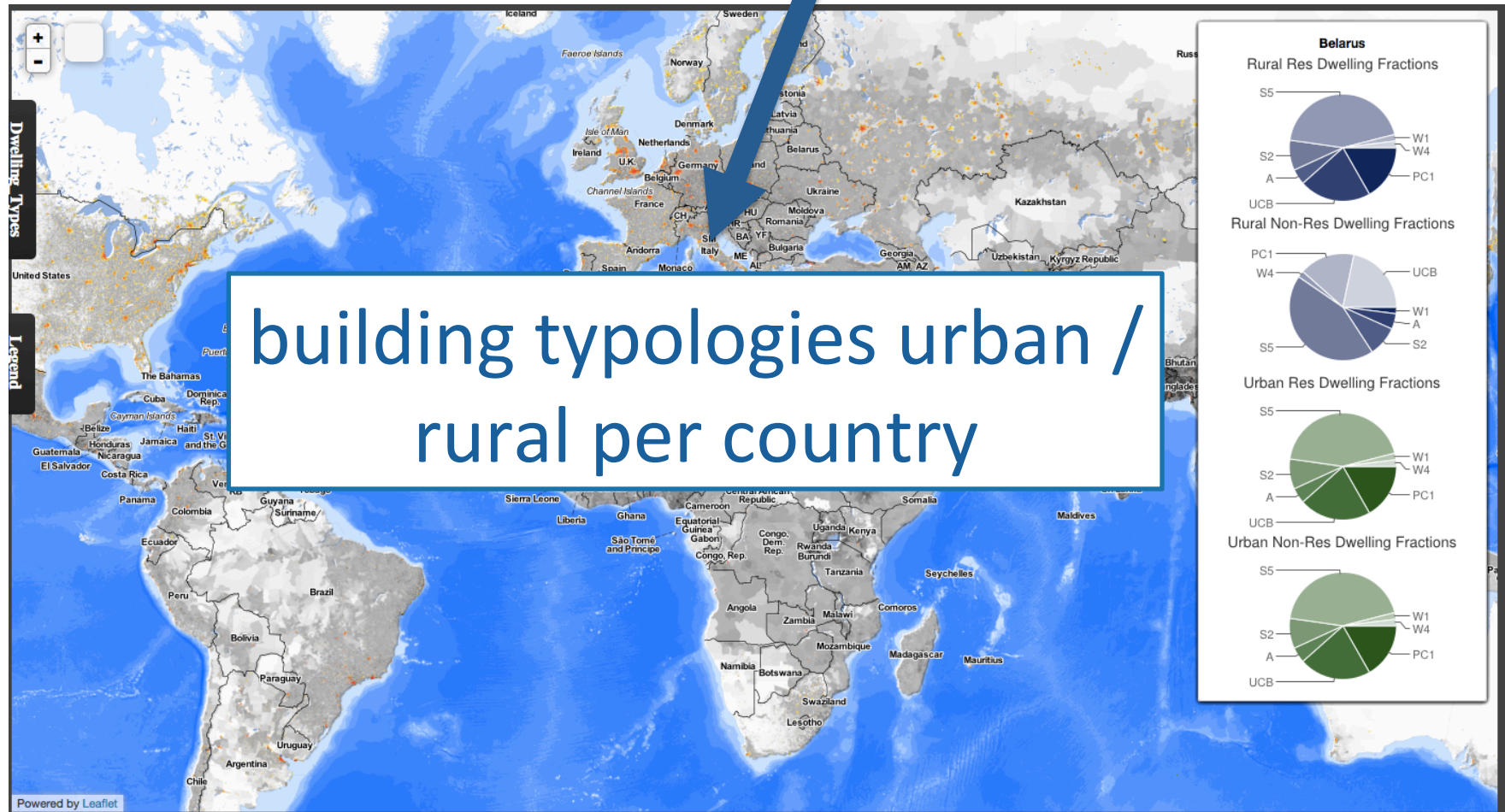
- OpenStreetMap
- Google Hybrid
- Google Terrain

events from the  
Instrumental Catalogue

# VIEW global datasets



# VIEW global datasets



# VIEW and use models and results

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## Input Models

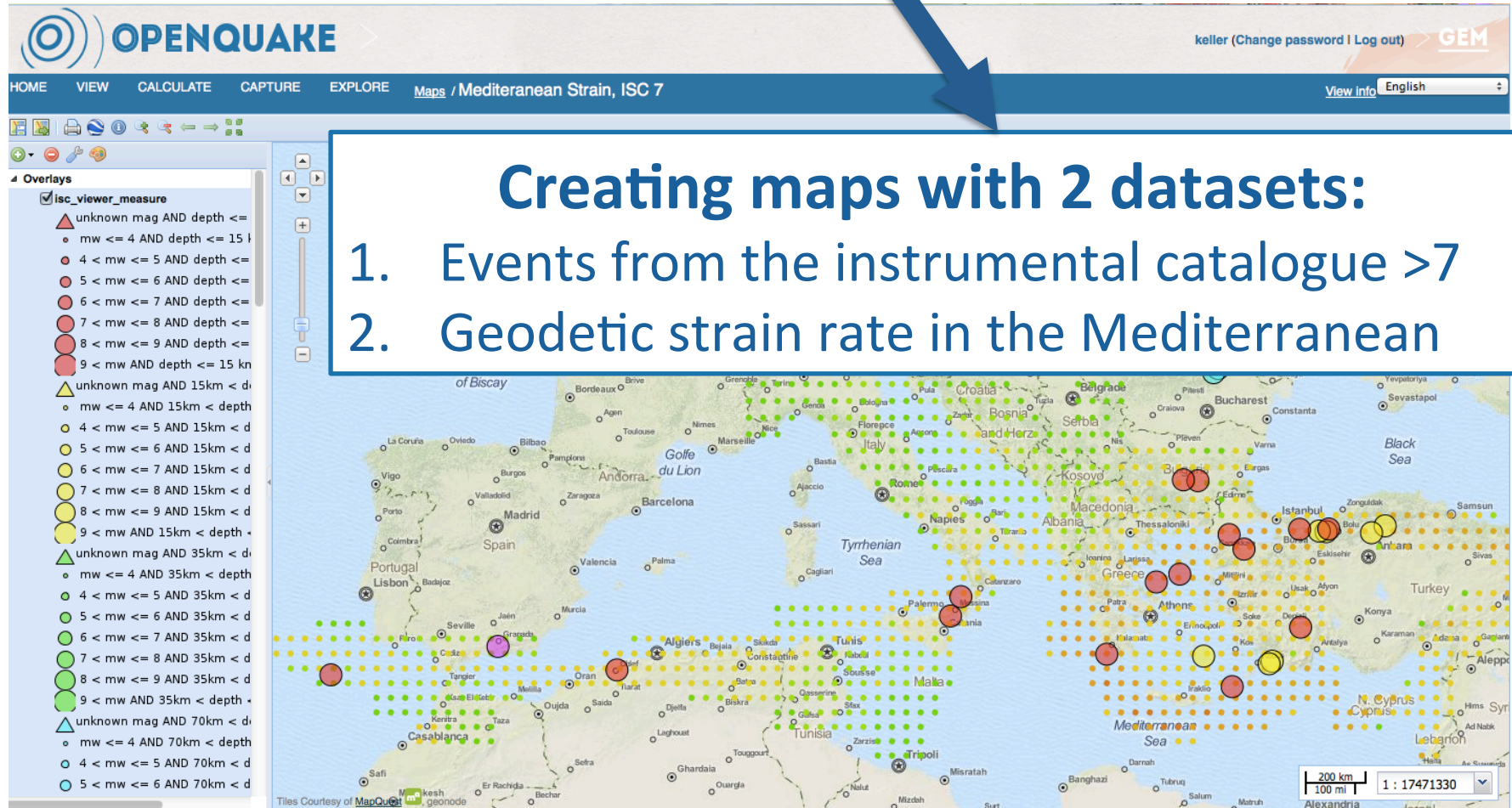
(regional and global)

- Seismic source models
- Ground motion models
- Physical exposure models
- Physical fragility and vulnerability models
- Ground motion fields
- Uniform Hazard Spectra
- Scenario Spectra
- Disaggregation plots (hazard and loss)
- Physical risk maps
- Loss curves

## Results

- Hazard maps
- Hazard curves
- Stochastic event sets
- Average annual losses (total and insured)
- Cost-benefit ratios
- Event loss tables (total and insured)

# EXPLORE risk data and information



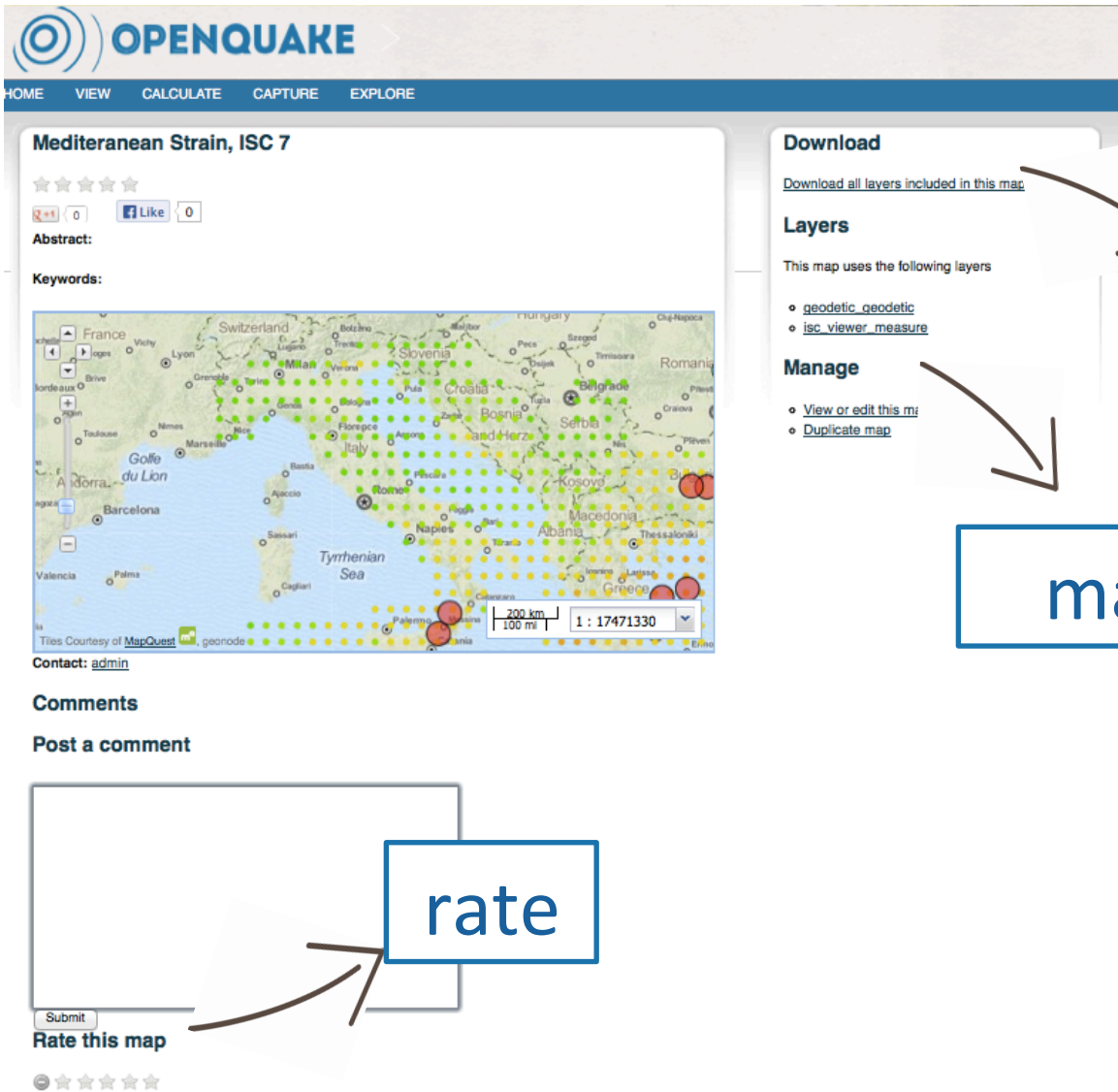
# CAPTURE new data (and contribute it to global databases)

**Active Fault Data Capture Tool**

Geologists can draw and input information on new fault discoveries and use the processed data for further application. They can also share it with GEM to improve the global active faults database

	Upper seismog...	Upper seismog...	Upper seismog...	Upper seismog...	Lower seismog...	Lower seismog...	Lower seismog...
vi...	0.0	0.0	0.0	1.0	12.0	18.0	15.0
	0.0	0.0	0.0	2.0	15.0	20.0	17.5

# SHARE maps, results and more, rate products for everyone's use



**OPENQUAKE**

HOME VIEW CALCULATE CAPTURE EXPLORE

### Mediterranean Strain, ISC 7

☆☆☆☆☆

0 0 Like 0

**Abstract:**

**Keywords:**

Contact: [admin](#)

**Comments**

Post a comment

Submit

**Rate this map**

☆☆☆☆☆

download

manage & edit

rate

## (4b) The Engine

**currently the only free, true open-source  
developed and available software for  
(earthquake) hazard and risk modelling**

**Open-Source**

**Test-Driven**

**Rich Set of Functionalities**

## (4b) The Engine

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**The OpenQuake Engine is state-of-the-art software for seismic hazard and risk assessment at varying scales of resolution (global < > local)**

- ✓ fully transparent
- ✓ can be used with GEM or user-developed models
- ✓ to carry out scenario-based and probabilistic calculations
- ✓ and produce a great variety of results
- ✓ used on a cluster, in the cloud or on a laptop

## (4b) The Engine

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- ✓ Being used worldwide; for national and regional hazard assessment, risk assessment
- ✓ 300+ (trial)users from 80+ countries, also as part of international trainings
- ✓ Trial calculations being carried out at country and regional level to test software together with private and public partners

## (4b) The Engine

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### **Hazard: classical, event-based, disaggregation, scenario**

- ✓ source typologies (point, area, simple fault, complex fault)
- ✓ earthquake rupture forecast creation for different tectonic regimes
- ✓ Stochastic event sets, ground motion fields
- ✓ model epistemic uncertainty via logic trees

### **Risk: classical, event-based, scenario**

- ✓ insured loss and cost-benefit ratio extensions model
- ✓ correlation of vulnerability uncertainty
- ✓ run from pre-calculated hazard
- ✓ disaggregation of losses by building typology

## (4c) The Desktop Tools

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- ✓ Desktop tools for collecting and processing data, preparing a calculation using the Engine
- ✓ First version of Event Catalogue Homogenization *available from [github.com/gem](https://github.com/gem)*
- ✓ QGIS integration experiments in progress
- ✓ Inventory Data Capture Tools in development *android tablet, windows laptop, protocols*
- ✓ Social-economic indicator and integrated risk toolkit - prototype under development

# GEM Now: what is already available?

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## ▶ Databases

- **ISC-GEM Instrumental Earthquake Catalogue**
- Historical Earthquake Catalogue coming soon (June 2013)

## ▶ Software

- All source-code open and available (GitHub, since 2011)
- Packaged software when needed, no user-interfaces yet though
- Fault Capture Tool

## ▶ Services and support for using the software

- Web-based service to use the **OpenQuake Engine (OATS)**
- Manuals and books

# GEM Now: what is already available?

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## ▶ Best practice, guidelines

- (Interim) Scientific and Technical Reports
- GEM **Building Taxonomy**
- **GMPE reports** coming soon (April 2013)

## ▶ Knowledge sharing resources and apps

- GEM Building Taxonomy **Glossary** with 800 definitions and 250 photos
- TaxT: app for creating building reports worldwide
- Semantic wiki and ontology for socio-economic vulnerability

*See.. [www.nexus.globalquakemodel.org](http://www.nexus.globalquakemodel.org)*

# Get involved!

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- ▶ **PARTNER:** Join or sponsor the effort, develop and implement strategic projects and programmes together
- ▶ **EXPLORE:** Try GEM products as they become available and provide feedback
- ▶ **USE:** Take advantage of reports, knowledge sharing apps, videos and more
- ▶ **SCIENCE:** Use and provide feedback on the guidelines and other global best practice
- ▶ **DATA:** Collaborate on data to enhance the global datasets for everyone's use
- ▶ **DEVELOP:** Join one of our open-source projects
- ▶ **FOLLOW:** Stay up-to-date through our website and newsletter
- ▶ **REGION:** Share knowledge and data within a regional partnership, participate in workshops



# Supporting increased earthquake resilience around the globe

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*GEM: a unique collaborative effort*



working together to assess risk



**GLOBAL EARTHQUAKE MODEL**

# How the GEM Foundation works

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- ▶ A small **Secretariat** links up all activities and output from global projects, regional collaborations and IT, turning them into products and resources for all
- ▶ The **Governing Board** oversees all GEM activities
- ▶ The **Scientific Board** advises the Governing Board.
- ▶ The **Model Facility** unites all IT activities.
- ▶ The **Testing & Evaluation** Facility warrants the quality of models

# (4a) The Platform


**From global to local: the platform & tools become more valuable over time for local decision-making**

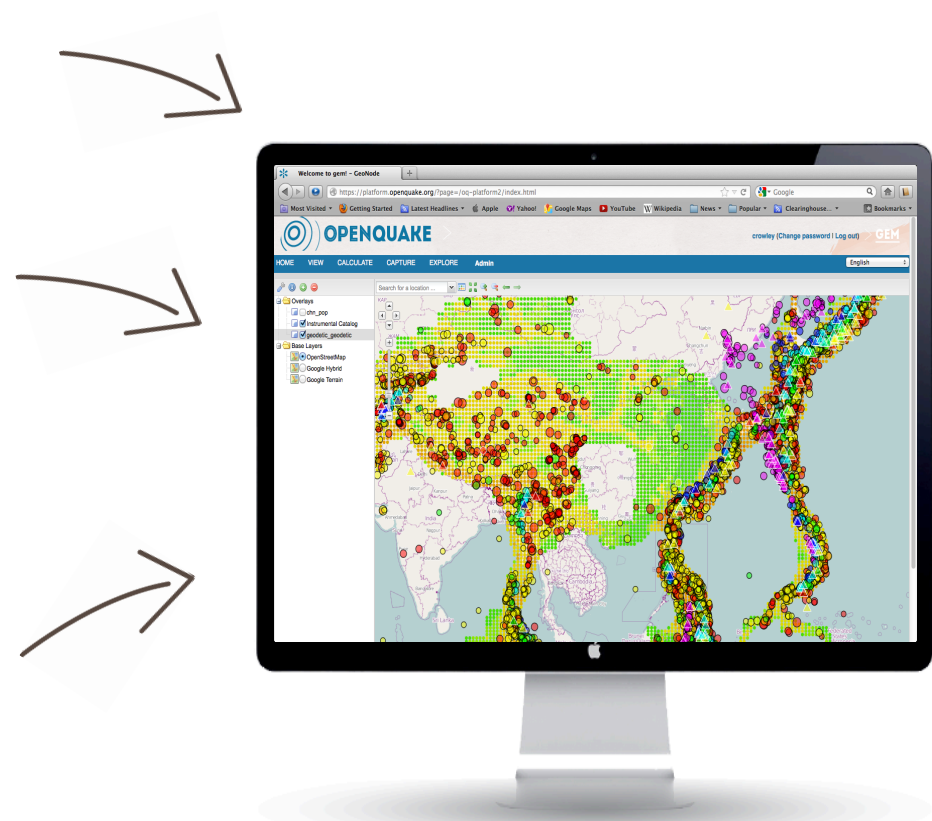
Organisations and individuals  
(data, results) 



Local - national, regional -  
programmes & collaborations  
(data, methods) 



Global Framework  
(tools, data, methods) 



# Serving stakeholders worldwide

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The platform and OpenQuake tools are developed around 2 types of users:

## POWER USERS

- ✓ Mainly **academics, risk consultants, insurance and large (engineering) companies, technical agencies**
- ✓ Interested in and have background knowledge to..
  - ✓ develop and enhance **earthquake hazard and risk models**,
  - ✓ execute custom calculations, setting the parameters as desired

## GENERAL USERS

- ✓ All those that want to view and overlay datasets, access maps or projections of hazard and risk, to **inform decision-making and increase risk understanding**
- ✓ From **emergency management agencies to individuals** and from **multinationals to international/local (non-profit) organizations**.

# Learn more...

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

# (4a) The Platform

Ready-to-use-maps, graphs and other resources support insight into possible **damage** or **loss**.

Initially these **products will be 'global'** and provide a rough overview. For detailed decisions at the local level they are too uncertain.

Through collaboration, more and more results and resources can be applied for **local risk assessment** after 2014.



**OpenQuake**  
Calculate, Share, Explore

