GLOBAL EARTHQUAKE MODEL

Working together to assess risk

MEETING THE NEED

FOR INCREASED EARTHQUAKE RESILIENCE

IN A NUTSHELL

25+ public and private organisations sustaining the effort

250 + leading experts developing global best practice, datasets and tools

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

65+ countries where stakeholders have tested transparent modeling with the OpenQuake Engine

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

10+ training and technology transfer activities carried out worldwide



Vulnerability to earthquakes is increasing, yet reliable risk assessment tools and data are out of reach in many areas of the world. There are few global standards that allow us to compare seismic risk, yet recent events have taught us that we need to work together globally to improve our understanding of earthquake behaviour and consequences.

The Global Earthquake Model (GEM) was created to bridge these critical gaps, and thereby support risk awareness and actions that increase resilience. GEM is a public-private effort to collaboratively develop and use cutting-edge tools and resources to assess the likelihood of earthquakes and their consequences for societies and economies worldwide. By pooling data, knowledge and people, GEM acts as an international forum for collaboration and exchange, and leverages the knowledge of leading experts for the benefit of society.

The non-profit and independent GEM Foundation that drives the effort, is funded and governed through a unique public-private partnership. Datasets, models, tools and results are developed by hundreds of experts on global and local scales. The open-source OpenQuake software, with at its core a web-based platform, will from 2014 allow a wide range of stakeholders to work together and improve earthquake risk assessment worldwide.

INTEGRATED RISK ASSESSMENT

GEM takes pride in collaboratively taking risk assessment to the next level. In order to manage risk effectively, it is critical to understand all drivers of risk, and appreciate to what extent risk derives from possible ground shaking (hazard), the vulnerability and exposure of people and structures (physical risk) and the vulnerability of the socio-economic system to earthquakes.

Global earthquake hazard analysis is for the first time measured using both our knowledge previous earthquakes as well as our understanding of how the earth is being deformed (strained) in response to tectonic (geologic) forces. At regional scales, the data and models of earthquake behaviour are developed together with local experts to produce a reliable basis for analyzing hazard from earthquakes.

Potential losses from earthquakes in terms of damage to structures and people can be estimated for the first time on a global scale and in a consistent manner. Indicators of social vulnerability, resilience and indirect economic loss can be coupled to physical risk (loss and damage estimates) in order to assess risk holistically.

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

due to earthquakes

Probability of ground shaking

EXPOSURE

Elements at risk

PHYSICAL VULNERABILITY

Vulnerability of structures and their occupants to seismic hazard

THIS FRAMEWORK GUIDES DEVELOPMENT OF TOOLS AND (SCIENTIFIC) RESOURCES

SERVING STAKEHOLDERS WORLDWIDE

GEM stakeholders include a wide range of organisations and profiles. We aim to serve all with our products, services and resources in various ways. The platform and its related tools support many different workflows, but are developed around two main types of users: 'power users' and 'public users'.

- POWER USERS

Mainly academics, risk consultants, insurance and large engineering companies that are interested in and have the background knowledge to develop and enhance earthquake hazard and risk models, and in executing custom calculations, setting the parameters as desired.

- PUBLIC USERS

All those that want to view and overlay datasets, access maps or projections of hazard and risk, to inform decisionmaking and increase risk understanding. Users that we envisage range from governmental agencies to individuals and from multinationals to international/local (nonprofit) organizations.

Stakeholders are able to use most products in noncommercial/non-profit contexts independently, following the different licenses that apply for the products.

For companies that would like to use them in for-profit contexts we propose a strategic partnership that contributes to the sustainability of GEM.



"GEM will provide communities with a great opportunity to strengthen their capacity to respond to disasters, invest in disaster reduction and therefore make themselves stronger and more resilient"

CLAUDIO BOETTCHER ZURICH INSURANCE GROUP

AIDING DECISIONS TO MANAGE RISK

We actively work with partners and other organisations to ensure GEM tools and resources support risk management and link up with ongoing efforts. Readyto-use-maps, graphs and other resources will support insight into possible damage or loss. Indices and tools help to also take into account the social-economic context. Initially these products will be 'global' and provide a rough overview. For detailed decisions at the local level they are too uncertain, but through worldwide collaboration, more and more results and resources can be applied for local risk assessment after 2014.

TRANSPARENT RISK MODELING

Together with collaborators worldwide we are developing both global 'uniform' models, as well as local models for independent risk modeling. The models serve as input to a variety of calculations that can be carried out to produce tables, plots, maps and other products that inform risk financing and transfer strategies as well as policies and planning strategies more effectively. We are keen on featuring as many national and regional models in our platform as possible. The tools will allow for extensive treatment of uncertainties and checking of output. Cost-benefit analyses can be carried out for retrofit and insurance investments.

ADVANCING SCIENCE

Sharing of data and (scientific) knowledge across boundaries is key to improved risk assessment and risk management. GEM fosters international and interdisciplinary collaboration between leading scientists, experts, and professionals through large and small projects, working groups and meetings. Findings are shared online as much as possible to allow the wider scientific community to benefit, discuss and improve the results, as well as to achieve genuine collaboration between academia, private and public sectors, and international entities to advance the science around earthquake risk together.

We are on-track for the 2014 delivery of the OpenQuake platform, the community-driven environment from where the OpenQuake suite of open-source software tools can be accessed to assess and model risk.

The platform serves as a hub for integrated earthquake risk assessment allowing power and public users to combine GEM products in many different ways to obtain output for science, risk assessment, risk awareness creation and risk management.

AN INTEGRATED SUITE FOR RISK ASSESSMENT





Sharing of data and risk information, best practice and approaches is key to assessing risk better. The platform is to serve as a clearinghouse for all those critical inputs and outputs. It will link users from around the globe so they can work together to assess risk.

> Regional projects and individuals from 80+ countries use the cutting-edge OpenQuake Engine. Visit our website to try a command-line version of the tool, and learn about the other OpenQuake tools.

EXPLORE

The platform leverages upon open-source geospatial technologies to allow users to work in an intuitive, mapbased environment. Users can explore earthquake hazard and risk by interacting with dynamic maps, indicators and graphs. They can also develop their own maps by combining datasets, and they can upload new data for continuous improvement of datasets for (local) risk assessments.

CALCULATE

The OpenQuake Engine is GEM's state-ofthe-art software for seismic hazard and risk assessment at varying scales of resolution, from global to local. It can be used on a cluster, in the cloud or on a laptop. It is open-source, fully transparent and can be used with GEM or userdeveloped models to carry out scenario-based and probabilistic calculations. Users can produce many different types of output related to hazard, loss and damage (maps, curves, plots and much more).



COST-BENEFIT ANALYSIS

Cost-benefit maps such as the one displayed here, can be created with OpenQuake. They help support decisions on when and where to retrofit buildings.

The OpenQuake Engine can create the files for these maps at local scales, after experts in your area of interest input the necessary data and information on the vulnerability and exposure of the buildings. Global maps for rough comparisons will be accessible from the platform.

THE PRODUCT OFFERING

We are working to provide you access to a wide range of products and services

- An integrated platform for earthquake risk assessment
- Unique global uniform earthquake-related datasets
- A suite of open-source software tools
- Maps, indices, graphs and many other hazard and risk projections

- Methods, best practice and guidelines for hazard and risk assessment
- Input models for risk modeling: global, regional and national
- A website with reports, infographs, news and events
- Knowledge sharing apps and resources

Many of GEM's products are resources in their own right, but their value increases by being able to combine them inside the platform. Some of the products are to be combined in an integrated workflow to perform a certain task.

110 YEARS OF SEISMIC HISTORY FROM 20.000+ EVENTS

One of the tangible outcomes of international scientific collaboration in GEM is the ISC-GEM Global Instrumental Catalogue. An international group of experts brought together over 20.000 events (of magnitudes 5.5 upwards) in a homogeneous way and together with GEM released it publicly in January 2013.

The catalogue can now be used for seismic hazard calculations, reference for development of regional catalogues, in general for a deeper understanding of our seismic history and as a basis for further research.

More and more of such unique databases and other products are becoming available. Keep an eye on the website and check out when products & services are (becoming) available.

THE ACTIVITIES WE CARRY OUT...

- Through global projects and working groups we work on global state-of-the-art science
- Regional collaborations allow local experts to leverage tools and best practice created within the scope of GEM.
 By creating networks and programmes or linking up with existing, the GEM Secretariat facilitates development of hazard and risk assessments at local scales.
- Continuous testing and improvement of tools, models and best-practice takes place, in interaction with the community, to make sure that they are of good quality, as well as meet the needs of stakeholders

- Open-source software development leads to creation and deployment of the OpenQuake suite of tools and interactive risk assessment platform
- All activities are duly coordinated to make sure that all output (data, tools, models) are compatible and to be able to integrate them into products and resources with the platform as the wider context
- Learning, knowledge exchange and technology transfer are facilitated through the website, workshops, knowledge sharing apps and training sessions as to provide our stakeholders with products and skills to leverage on GEM tools and resources



HOW WE WORK

GEM people and products are making a difference around the world...

UNIQUE COLLABORATIONS

True synergy is created by organisations that work together in the scope of GEM. The Global Exposure Database project for example pools knowledge and data on people and households (CIESIN, UN-HABITAT), satellite images and remote sensing (JRC, ImageCat, University of Pavia), damage and loss assessment (USGS, Geoscience Australia). The collaboration adds great value to the work the organizations do individually and is not only resulting in a unique dataset of buildings and population worldwide, but also in new insights to apply the data and knowledge.

BUILDING ON CAPACITY

Technology transfer and training are an integral part of GEM. So far workshops have taken place with scientists from Africa, Central Asia, the Balkans, South and South-East Asia, featuring sessions on hazard and risk assessment, as well training in OpenQuake software.

Georges Mavonga Tuluka, Seismologist in Goma, Democratic Republic of Congo: "It is great to finally use sophisticated software for free. In Congo we do not have many resources and even though the tools are still under development, they are exactly what I need to assess hazard in my area."

OUR VISION

Thanks to our worldwide community, GEM has grown to be an important and tangible reality. Through this collaborative effort we strive to change the landscape of earthquake risk assessment and thereby support risk understanding, mitigation and management. Release of the first version of the OpenQuake platform and related resources will only be the start.

From 2014 onwards we plan to...

- leverage OpenQuake, supporting a worldwide community in carrying out hazard and risk assessment and in sharing their outputs and knowledge through the platform, whereby increasing its value.
- focus even more on regional collaboration, knowledge sharing and technology transfer.
- release OpenQuake platform v2.0 which incorporates better data, and advanced science that covers new areas, such as infrastructure and possibly tsunamis.

We envisage to do so with an ever-growing group of partners, collaborators and followers. Read more on our roadmap online and... be part of GEM too!



GET INVOLVED...

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

REGION: Share knowledge and data within a regional partnership, participate in workshops

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

WWW.GLOBALQUAKEMODEL.ORG

* Including photography from GFDRR, Seismic Research Centre at UWI, Taiwan Earthquake Model, Nicola Tarque, James Brown, NASA and USGS

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