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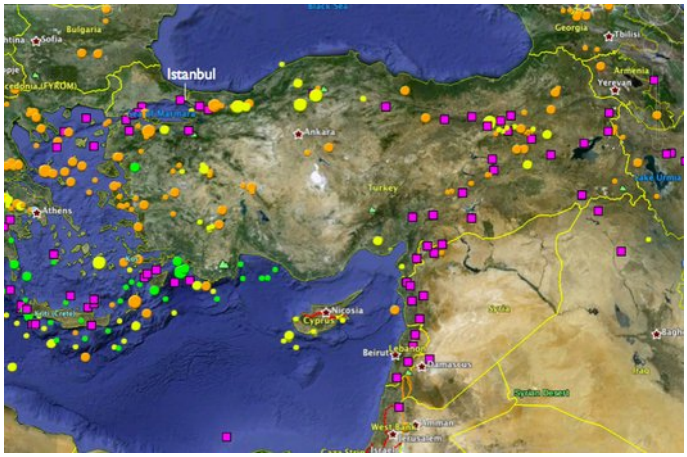
Reducing earthquake impact with big data and global collaboration

iSGTW recently interviewed Paul Henshaw and Damiano Monelli of the Global Earthquake Model foundation (GEM). GEM seeks to shake up the way in which seismic hazard and risk are calculated across the globe, thus saving lives and reducing the financial cost of earthquakes.



Pink squares represent data points from the historical catalog and colored dots show data from the instrumental catalog. Image courtesy GEM foundation. Front page image courtesy UCL Mathematical and Physical Sciences, Flickr, CC-BY 2.0.

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What is the GEM foundation?

PH: The GEM foundation is a public-private partnership and its objective is to produce global datasets describing earthquakes and their consequences, as well as tools to further the science of seismic risk assessment.

Who's involved?

PH: Our sponsors from the private side include many companies from the insurance and

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European editor

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reinsurance industries, civil engineering companies, and software companies, too. On the public side, we have geological surveys from various countries, civil protection agencies, humanitarian organizations, *etc.*

What do you do?

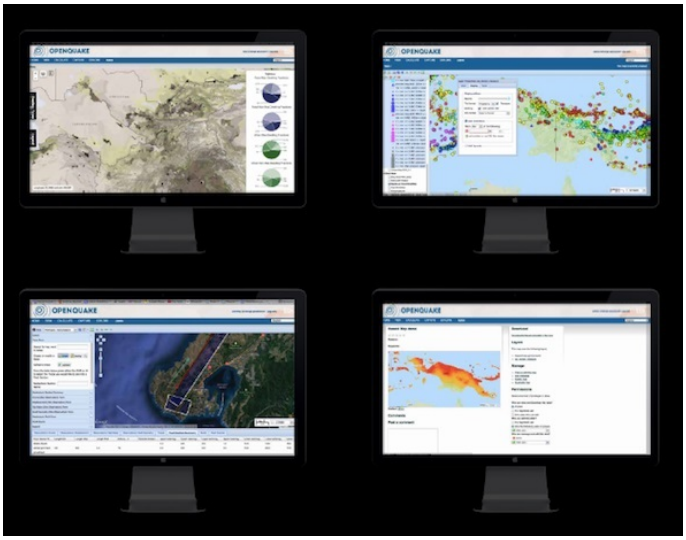
PH: We have collaborations with scientific consortia to produce global datasets. One example of this is the historical earthquake catalog. In collaboration with the INGV [the Italian National Institute of Geophysics and Volcanology] and others, researchers have gone back through archives and documents to produce a catalog of earthquake events for the last 1,000 years.

DM: All of this data will be made available online to the public. We also have another catalog that complements this called the instrumental catalog, which includes data that has been directly recorded by seismic networks over the last century.

How do you create a catalog with data on earthquakes stretching back almost a millennium?

DM: Basically, from historical documents you can try to give estimates of the intensity of earthquakes. People describe the damage caused by the events and, because we have an understanding of how people built their houses at a given time, we can approximate the magnitude of historical events, with a given amount of uncertainty, of course. This is, however, still useful information as it lets us

know where and when earthquakes have happened in the past and from this we can estimate average occurrence rates. It's a very important data set.



Screenshots from the OpenQuake platform. Click for larger version. Image courtesy GEM foundation.

What about the tools produced?

PH: In addition to these catalogs, we also have lots of other projects, too. As part of these projects, we have a group that has produced tools for collecting information. This includes software for Android tablets and Windows PCs, which enables them to be used to go out and gather data from buildings, including information about how their structure may have been damaged by earthquakes. These tools and datasets will be included in the OpenQuake platform. Users will be able to go out and collect data about buildings before and after an earthquake event and share that information with us using a taxonomy for describing buildings, which was created by consortia within GEM.

We have datasets, tools, and standards that have been developed in collaboration with experts all around the world. But this is just one of the activities that GEM undertakes. There are also regional programs which complement the global data set approach with local knowledge from experts in a given region.

DM: The idea is basically to interact with scientists in different regions of the world to build hazard and risk models. GEM has been working in Europe with an EU-funded project called SHARE [Seismic Hazard Harmonization in Europe], which has produced a new seismic model for the region. There are similar initiatives around the world, such as Earthquake Model for the Middle East and Earthquake Model Central Asia. We are also now starting another regional initiative called The Seismic Risk in South America project.

Perhaps you could explain to the *iSGTW* readers your motivation for doing this and for making all of this data available online?

PH: Most people who are at risk from earthquakes often don't know the real extent to which they're at risk. And, even for those cases where people do know that they're at risk, it can often be difficult to compare the data from one region with another, because they've often not been collected in the same way.

DM: Hazard and risk aren't always modeled in the same way around the world, so there are huge disparities. There are regions where the analysis is

very advanced and other regions where the knowledge is actually very poor. GEM is trying to fill these gaps and create a global community that can work on homogeneous standards and understanding of seismic hazards and risk. Currently, knowledge is not always as accessible or as transparent as it should be, so GEM is also embarking on an effort to make calculation of seismic hazard and risk a more transparent process. This way, interested people can really understand how these numbers are computed and where they're coming from. Everything that GEM does is open: both the data and the software itself.

PH:

Ross Stein, co-founder of GEM, talks about 'defeating earthquakes' at Ted^{x} Bermuda. Video courtesty Ted^{x} Bermuda.

Having a calculation engine that's open source - where the users can see how the calculation is performed and what assumptions have been made - is very important. Open data, combined with open-source calculation in this manner, means that anyone can see how we got a particular set of numbers in a completely transparent manner. By comparison, the existing commercial tools are not usually open and transparent in this way and it can

sometimes be difficult to see how calculations have been performed and what assumptions have been made. This transparency aspect is not just considered very important by our public sponsors, but also by our private sponsors, too.

How about volunteer computing? Does that play a role in your plans?

PH: We're interested in volunteer computing platforms, both as a means of communicating information about GEM and as a way of doing something useful following earthquake events. After earthquake events, people are often keen to do something. Perhaps after an event people realize that they're more vulnerable than they previously thought and a want to run their own calculations. But there are also others who just want to help out. So, we feel that there is a potential there that we should investigate... it's a very exciting idea.

DM: Yes, volunteer computing could be a great way to work with people in developing countries, who may not necessarily otherwise have access to computation infrastructure.

So, what's next for the project?

PH: Well, we've just released the first version of the calculation engine, and we are now working on the desktop tools to help users prepare input for the engine. We're also going to continue working on the web-based platform and we've built a web interface that allows users to run calculations without having to use the command line. I see a great deal of value

in this for our training workshops and for our own cloud-based system, which allows users to run simulations. We need to continue working on this to add features and make it more user-friendly.

We need to port our engine to a small virtual machine, so as to run in a voluntary-computing environment - that's something I'd like to try to get started over the next few months. We will also continue to work with the regional programs, and there are lots of other things going on, too.

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