Plate tectonics observatory to create seismic shift in earthquake research

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A 6.2-magnitude earthquake in Amatrice, Italy, in August 2016 killed nearly 300 people. Credit: Amatrice Corso by Mario1952 is licensed under Creative Commons CC-BY-SA-2.5 and 2016 Amatrice earthquake by Leggi il Firenzepost is licensed under CC BY 3.0

We may never be able to entirely predict earthquakes such as those that hit central Italy in 2016, but we could better assess how they're going to play out by joining up data from different scientific fields in a new Europe-wide observatory, say scientists.

In 2016 and early 2017, a series of major earthquakes rocked central Italy. In the hill town of Amatrice, one magnitude-6.2 earthquake devastated the town and claimed the lives of nearly 300 people, with

hundreds more injured.

Richard Walters, an assistant professor in the Department of Earth Sciences at Durham University, UK, has been studying a variety of datasets to understand how these quakes played out. He and his colleagues found that a network of underground faults meant there was a series of seismic events rather than one major earthquake – a finding that could help scientists predict how future seismic events unroll.

"We were only able to achieve this by analysing a huge variety of datasets," said Dr. Walters. These included catalogues of thousands of tiny aftershocks, maps of earthquake ruptures measured by geologists clambering over Italian hillslopes, GPS-based ground-motion measurements, data collected by a satellite hundreds of kilometres up, and seismological data from a global network of instruments.

"Many of these datasets or processed products were generously shared by other scientists for free, and were fundamental to our results," he said. "This is how we make big advances."

At the moment, this type of research can rely on having a strong network of contacts and disadvantage those without them. That's where a new initiative called the European Plate Observing System (EPOS), set to launch in 2020, comes in.

The aim is to create an online tool that brings together data products and knowledge into a central hub across the solid Earth science disciplines.

"The idea is that a scientist can go to the EPOS portal, where they can find a repository with all the earthquake rupture models, historical earthquake data and strain maps, and use this data to make an interpretative model," said Professor Massimo Cocco, the project's coordinator.

"A scientist studying an earthquake, a volcano, a tsunami, and so on, needs to be able to access very different data generated by different communities."

Mosaic

At the moment, findings on solid Earth science at a European scale are scattered among a mosaic of hundreds of research organisations. The challenge is to incorporate a variety of accessible information from many different scientific fields, using a combination of real-time, historical and interpretative data.

EPOS will integrate data from 10 areas of Earth science, including seismology, geodesy, geological data, volcano observations, satellite data products and anthropogenic – or human-influenced – hazards.

It will help build on the type of data integration that happened after the Amatrice quake, in which the lead organisation behind EPOS – Italy's National Institute of Geophysics and Volcanology (INGV) – was involved in coordinating and fostering data sharing.

This included real-time data from temporary sensor deployments, as well as seismic hazard maps, satellite data products and geophysical data – leading to a first model of the quake's causative source within 48 hours to aid emergency planning.

So far, a prototype of the portal has been developed and it will now be tested by users over the coming year to make sure it meets needs.

Dr. Walters said that EPOS is right on time. "Projects like EPOS are especially timely and valuable right now, as many of the subdisciplines that make up solid Earth geoscience are entering the era of big data," he said.

Eyjafjallajökull

The eruption of Icelandic volcano Eyjafjallajökull in 2010 highlights another issue that EPOS is hoping to improve – the challenge of coordination across borders. Though this event did not cost human lives, it had a much wider impact in Europe, leading to flights being grounded throughout the region and costing airlines an estimated €1.3 billion.

In such cases, said Prof. Cocco, it helps to know factors such as the ash's composition, something that affects how a plume travels but is not necessarily included in the models of meteorologists. That knowledge could be gained through access to volcanology data, and also used by aviation authorities and airlines, potentially to design systems to protect engines.

Prof. Cocco said the idea is that EPOS could also be used by people outside the research community to 'increase the resilience of society to geohazards." An engineer or organisation could use data on ground shaking or earthquake occurrence to aid safe exploitation of resources or evaluate risks in building a nuclear power plant, for example.

In addition, the aim is to make it easier for students or young scientists to interpret data through tools, software, tutorials and discovery services, rather than having access to just raw data. "Otherwise, you are providing only usability to skilled scientists," said Prof. Cocco. "This, to me, is the only way to achieve open science."

At present, the EPOS community comprises about 50 partners across 25 European countries, with hundreds of research infrastructures, institutes and organisations providing data. The organisation has, meanwhile, submitted a final application to become a legal entity known as a European Research Infrastructure Consortium (ERIC), with a decision establishing the ERIC expected within the next two months. This official

status will aid integration with other national and European organisations, and have benefits in the allocation of funding, said Prof. Cocco.

Professor Giulio Di Toro, a structural geologist at the University of Padova in Italy, said it is great to have this type of hub to bring information together and improve access, but also important to ensure that it doesn't lead to an increase in bureaucracy. If institutions come up against funding issues, it could also pose a challenge to their ability to share data, he added: "If for some years you don't get grants, you will not produce data to share."

Meanwhile, Dr. Walters sees a positive spirit reflected in these types of initiative. "While in Europe's current climate politicians may be putting up borders," he said, 'scientists in those same countries are trying even harder to break down national barriers, and working together to build something better for everyone."

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