Earth-shaking research to predict devastation from earthquakes

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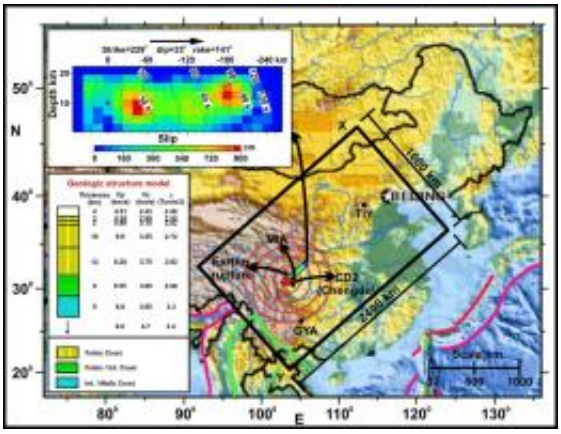

Simulation of the Great Sichuan Earthquake in China in 2008. Credit: UNAM

The computational science expertise at the Science and Technology Facilities Council's (STFC) Daresbury Laboratory is playing a key role in enabling researchers at the National Autonomous University of Mexico (UNAM), to develop a tool that will make it possible to estimate the likely impact of large magnitude earthquakes at specific locations, before they happen.

Led and funded by the Institute of Engineering of UNAM, the project has closely studied the propagation of seismic waves through the earth's crust during a number of major earthquakes, including the Magnitude Scale (Ms) 8 earthquakes that heavily damaged Mexico City in 1985 and the Great Sichuan Earthquake in China in 2008. Using this background

experience, Daresbury's computational scientists have been working with UNAM on the further development and optimisation of the simulation code for use on the world's leading computer systems. As well as looking at past events, the work is capable of studying ground motions from hypothetical earthquakes in vulnerable regions, and identifying where the ground shaking shocks would be at their greatest, should the earthquake occur.

Dr Mario Chavez, researcher at UNAM said: "Our research means that governments, developers and planners across the world could soon have access to vital earthquake ground motion data that will enable them to assess the strength and impact of large or extreme magnitude earthquake scenarios in their own region. This kind of information could play a major role when working on the risk assessment for a facility site, such as a nuclear power station, or when designing homes, hospitals, schools, or any buildings, in determining how resilient they need to be in order to minimise the damage caused by an earthquake. It could also help to assess how adequate an area's emergency infrastructure would be in such an event. However, it is important to point out that we are not predicting that an earthquake will actually happen, or when it will happen, but to pose "what if" type scenarios such as, if an earthquake of a given magnitude does hit a specific area, first, how much and how fast the earth surface will move, and second, by using information of the resilience capacity of the existing or planned infrastructure in that region, what is the probable impact of the earthquake. We are very excited to be working with the computational scientists at STFC Daresbury, who are renowned world experts in engineering computing. Daresbury is one of the best computational modelling centres in the world."

Dr Mike Ashworth, Associate Director of the Computational Science & Engineering Department at STFC Daresbury Laboratory said: "For this project we have made use of the highest levels of performance on

parallel machines, allowing Dr Chavez to perform high resolution simulation to an accuracy and magnitude that has not been done before for this kind of research. We were able to optimise and develop a code on Daresbury's supercomputers which enabled us to run on thousands of processors simultaneously for many hours, where it had previously only been run with a few tens or hundreds for just a few hours at the Kanbalam supercomputer of UNAM. We followed this up by taking our code to HECToR, the UK's largest, fastest and most powerful academic supercomputer, based at the University of Edinburgh, where we were able to run more than 8000 simultaneous processes. This project required availability of much larger computing resources than is currently available in Mexico and we are therefore thrilled to be able to offer our expertise to Dr Chavez and his team in this very obviously worthwhile research. UNAM performs more than half of the research of that comes out of Mexico and we look forward to continuing to work with Dr Chavez in the future."

This collaboration has been made possible through The Scientific Computing Advanced Training project (SCAT), a European Commission funded project that brings together research groups in 10 world-leading academic and research institutions from six countries. SCAT aims to provide training in computational science for young scientists in Europe and Latin America, and to create long-term research partnerships.

Dr Richard Blake, Director of STFC's Computational Science and Engineering Department, said: "This kind of research is invaluable to nations worldwide, the UK included. Although we are not considered a country at risk of a large magnitude earthquake, minor ones can occur nearby a site of interest and resulting damage could be significant. This project is a great illustration of the growing importance of modelling and simulation of what happens naturally on Earth and computational science could help governments implement policies and plans to save the lives of

many thousands of people across the globe in years to come. We look forward to continuing to work with Dr Chavez in the future, particularly as we gear up for our new Hartree Centre at Daresbury, a unique national centre for high performance computing."

The Hartree Centre will be a new kind of computational sciences institute for the UK, based at the Daresbury Science and Innovation Campus in Cheshire, and will be one of STFC's Science and Technology Gateway Centres, following significant government investment. It will seek to bring together academic, government and industry communities and focus on multi-disciplinary, multi-scale, efficient and effective simulation.

Provided by Science and Technology Facilities Council