THE OPENQUAKE ENGINE

CUTTING-EDGE CALCULATIONS OF SEISMIC HAZARD & RISK

V1.0

The OpenQuake Engine is GEM's state-of-the-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 user-developed models to carry out scenario-based and probabilistic calculations and produce a great variety of outputs.

After 3.5 years of open-source test-driven development, the first version of the OpenQuake Engine is now available, together with a user instruction manual, tutorials and demo-files.

FOR RESEARCHERS

Stable, state-of-the-art, tested software for PSHA and seismic risk assessment with extensive attention to uncertainty modelling

FOR RISK MODELLERS

Reliable, science-based, transparent software for various types of loss and damage assessment, including cost-benefit analysis

FOR DEVELOPERS

Unique open-source project at the heart of a collaborative effort to support societies in becoming more resilient to earthquake risk

A GLOBAL ENGINE

The OpenQuake Engine combines hazard and risk calculations in a single software, but also supports hazard-only calculations and risk calculations with pre-computed hazard

7 calculators allow for flexibility in obtaining outputs that can be used for decision-making directly, or for further analysis

40 contributors wrote 388,146 lines of (Python) code to get to version 1.0

Comparisons and tests with other modelling software are ongoing to calibrate and improve performance of the Engine

Hundreds of researchers, modellers and other experts from 80+ countries have used and tested preliminary versions of the software

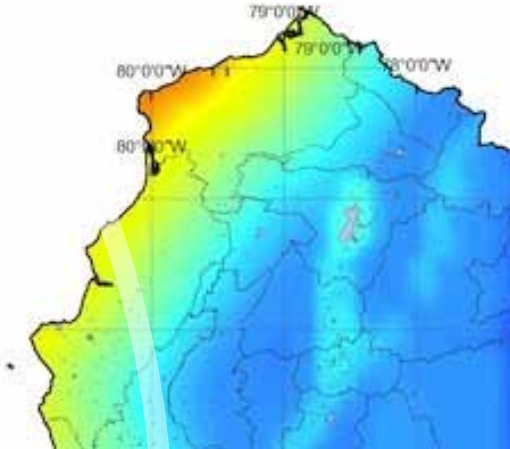
The Engine has been applied for verification hazard calculations of a nuclear power project, but also a new generation of hazard maps in Europe, the Middle East and Central Asia

Hazard assessments from national to global level have been carried out, the latter for example in the context of the UN's 2013 Global Assessment Report on Disaster Risk Reduction

A comprehensive risk assessment of 140,000 buildings in Tunis city was carried out with the software

V1.0

French and Ecuadorian scientists used the OpenQuake Engine to estimate seismic hazard for Ecuador, as the basis for a new seismic zonation map for the country's building code.



HAZARD CALCULATORS & OUTPUTS

CLASSICAL PROBABILISTIC SEISMIC HAZARD ASSESSMENT (PSHA):

hazard curves, hazard maps, uniform hazard spectra (UHS), disaggregation

EVENT-BASED HAZARD:

stochastic earthquake event sets and ground motion fields, hazard curves, hazard maps

SCENARIO HAZARD:

single event - stochastically generated ground motion fields

PHYSICAL RISK CALCULATORS & OUTPUTS

CLASSICAL PSHA-BASED:

asset-specific loss exceedance curves, average annual loss, loss maps, building typology disaggregation

EVENT-BASED RISK:

event loss tables, loss exceedance curves - asset specific and aggregated, average annual loss, loss maps, loss disaggregation

SCENARIO RISK:

loss statistics, loss maps

SCENARIO DAMAGE:

collapse maps, damage distribution per asset and building typology

FEATURES

- large set of source typologies for modelling faults as well as distributed seismicity
- explicit representation of uncertainty, including separation of epistemic (missing knowledge) from aleatory (random)
- logic tree support (representing epistemic uncertainty)
- calculates ground motion fields taking into account the spatial correlation of ground motion residuals
- accounts for spatially variable site conditions
- insured loss extension (based on simple limits and deductibles)
- benefit-cost ratio extension
- supported asset typologies: structure/ non-structural components/contents/ occupants
- vulnerability uncertainty correlation
- risk calculators can run with pre-computed hazard curves and ground motion fields

PERFORMING IN DIFFERENT ENVIRONMENTS

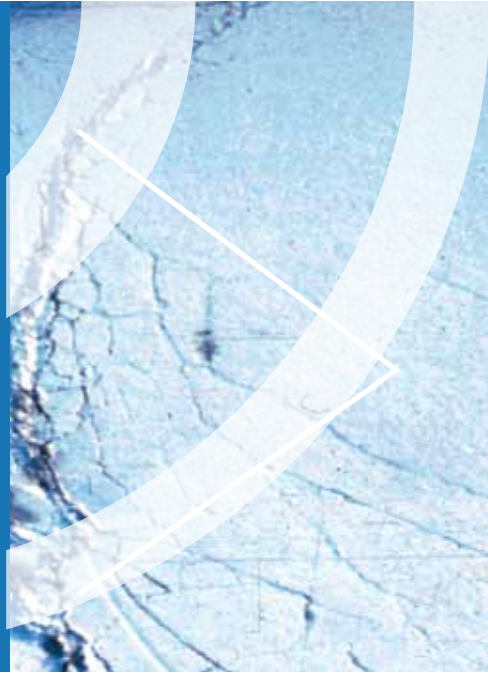
The OpenQuake Engine has been developed and optimised with large-scale regional and global calculations in mind, together with flexibility and a great variety of features and methods for modelling seismic hazard and risk. On a cluster, calculations can be carried out in just a few minutes or even seconds, but also on a single laptop a user would for example be able to:

- estimate the direct losses from a single earthquake using the median ground motion field and thousands of assets from tens of different building typologies in a matter of seconds
- calculate probabilistic seismic hazard curves and uniform hazard spectra for a site within a minute
- generate stochastic event sets containing thousands of earthquake ruptures, with finite fault geometries
- calculate probabilistic risk using a PSHA-based approach for a country the size of Italy in less than 30 minutes

Get started

All code can be found on GEM's GitHub repository. To test-drive the latest version of the software, stakeholders can freely access, investigate and provide feedback through the cloud-based OpenQuake Alpha Testing Service (OATS) before local installation on Ubuntu.

The software features a command-line interface and users can easily obtain sample outputs such as hazard maps, hazard curves, loss curves and maps of benefit-cost ratios by running demo-files.



www.globalquakemodel.org/openquake

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