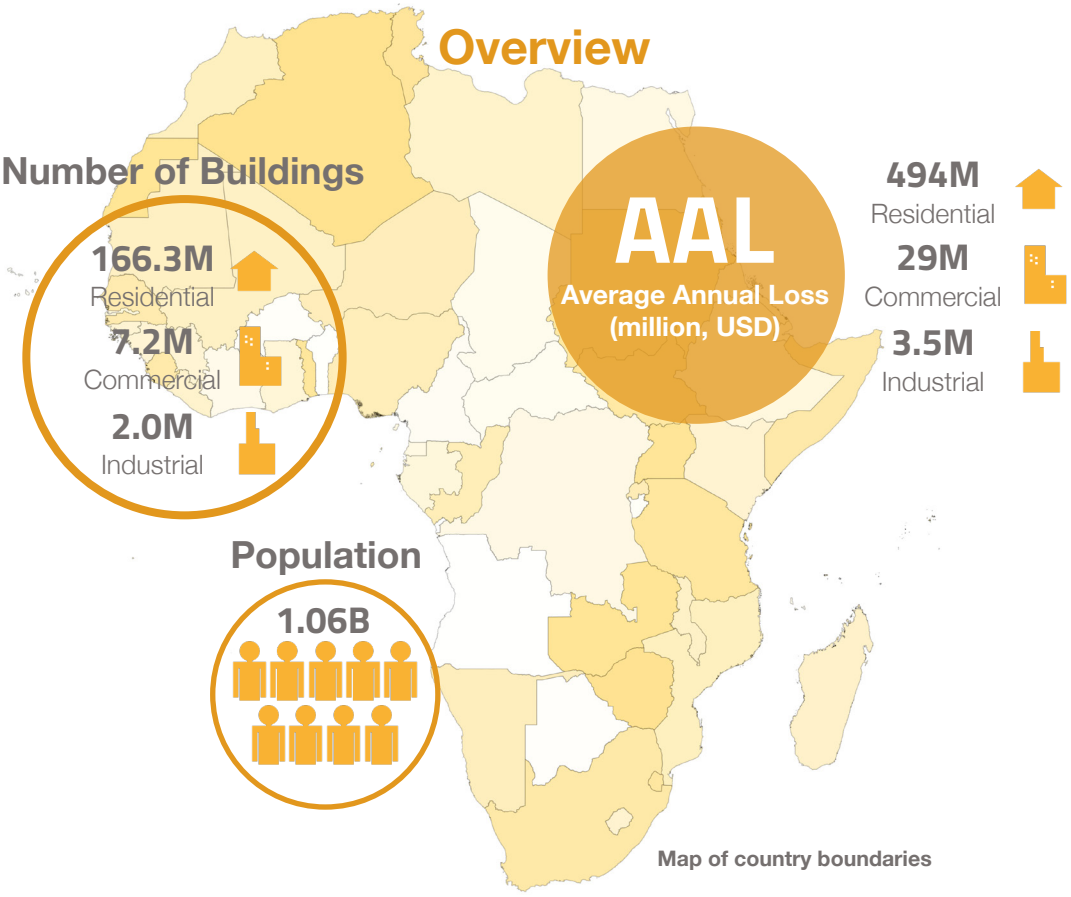
Understanding Earthquake Risk

AFRICA

Introduction

The Africa Earthquake Hazard and Risk model underpin the African portion of GEM's global maps released in December 2018. The Africa Model is composed of North Africa, West Africa, Eastern Sub-Saharan Africa and South Africa regional models, developed in collaboration with various African public and private institutions, national governments, and individual experts using the OpenQuake engine. For the complete list of sponsors and contributors, visit: https://www.globalquakemodel.org/gem.



How we built the model

The seismic hazard model includes four contributions: the SSAHARA project model funded by USAID covering Eastern Sub-Saharan Africa, models built by GEM covering North and West Africa, and the South Africa model by the Council for Geoscience, South Africa and the Indian Institute of Technology.

The seismic risk model, built within the scope of GEM's Global Risk Model with funding from USAID, used these hazard models with exposure and vulnerability models to estimate economic and human losses. This information represents the most comprehensive resource for risk assessment and loss estimation in the region.

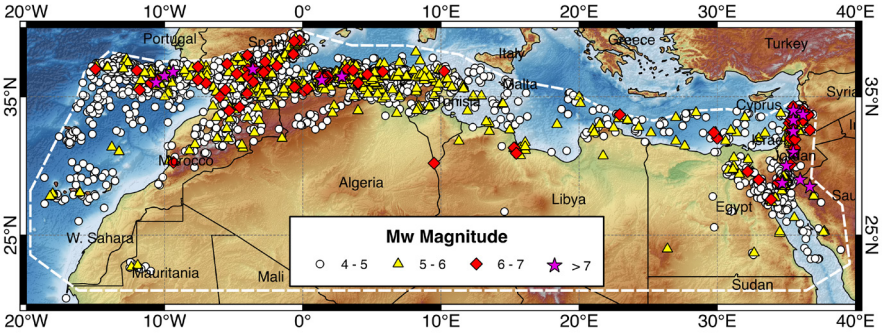
For what purpose and for whom

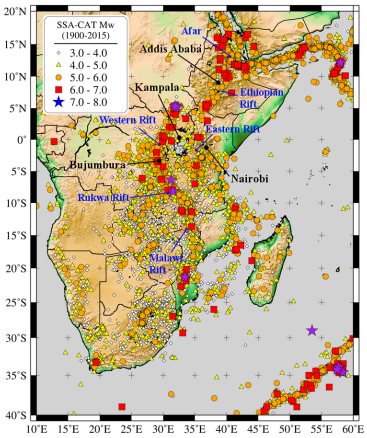
The Africa Earthquake Hazard and Risk model is based on the latest scientific data and represents a major step in understanding earthquake risk in Africa. The results can be used to understand earthquake risk at the sub-national, national and regional level, and as the basis for developing custom models and risk portraits at higher resolution, e.g., at city level. The results can be used by risk managers, urban planners, emergency responders and humanitarian agencies for input to a wide range of disaster risk reduction activities.

Hazard

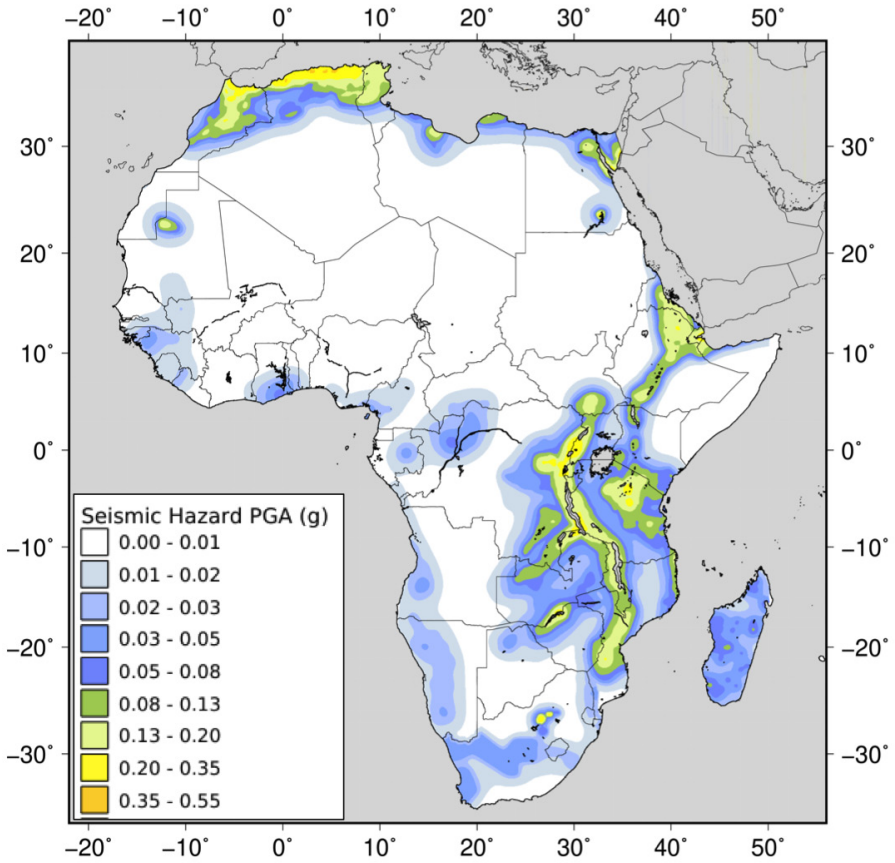
Using the OpenQuake-engine, the seismic hazard models for Africa can be used to calculate the hazard due to ground shaking for any given return period in terms of peak ground acceleration and a range of spectral acceleration periods. They can also be used to calculate stochastic event sets. The seismic source models are constrained by historic and recorded seismicity, and fault kinematics when available.

Most of Africa is considered to be tectonically stable, and so stable continental crustal ground motion prediction equations (GMPEs) are predominantly used. In northernmost Africa, where the Nubian and Eurasian plates converge, and in close proximity to the active East African Rift System, GMPEs for active shallow crust and volcanic regions are also used. Some models include weighted GMPEs in a buffer zone between different tectonic regions. The shaking hazard in Africa is generally considered to be low to moderate, with concentrations of hazard in the aforementioned active tectonic regions.





Above: North Africa Earthquake Catalogue (GEM-NAEC), presently consists of 5170 events with 4 ≤ Mw ≤ 8.5, covering a period from 1016 to 2013. **Right:** Declustered Sub-Saharan Africa-GEM catalogue consists of 7,259 events out of the original 29,803 in the magnitude range 3 ≤ Mw ≤ 7.53.



Above: The Africa Seismic Hazard Map shows the geographic distribution of the Peak Ground Acceleration (PGA) with a 10% probability of being exceeded in 50 years, computed for reference rock conditions (shear wave velocity, VS30, of 760-800 m/s).

Links

Documentation

Eastern Sub-Saharan Africa
https://hazard.openquake.org/gem/models/SSA

North Africa
https://hazard.openquake.org/gem/models/NAF

West Africa
https://hazard.openquake.org/gem/models/WAF

South Africa
https://hazard.openquake.org/gem/models/ZAF

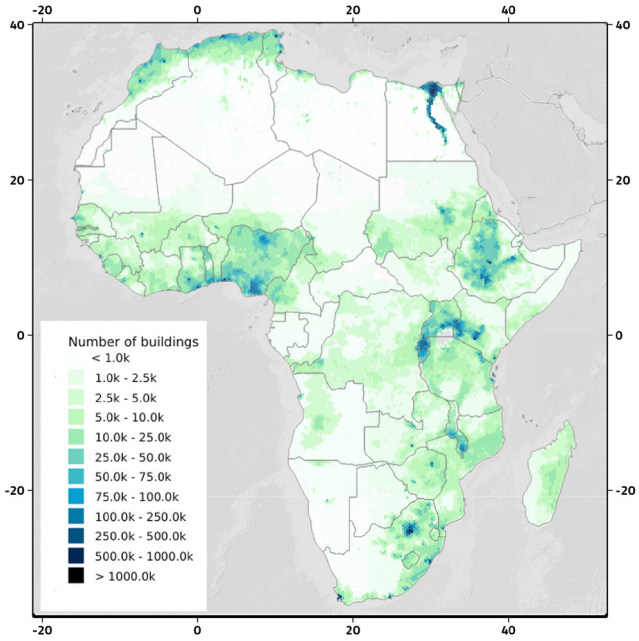
Data Files
https://s.gem.foundation/K9BS

Interactive Map
https://s.gem.foundation/K9BW

Risk

Though the seismic hazard for Africa is considered low to moderate, the impact of ground shaking is exacerbated by the high vulnerability of its built environment; these factors are captured by the risk model's exposed assets and vulnerability functions. The exposure database contains population, dwelling and building counts, structural characteristics, and replacement values at the lowest administrative level for 54 countries and two French territories.

The residential, industrial, and commercial buildings are grouped into 30 structural classes. Vulnerability functions are derived for each structural class employing nonlinear dynamic analysis on numerical models of the structures, and validated using historical events. A 20,000-year stochastic event catalog was used to estimate average annual losses, loss ratios and loss exceedance curves for all sub-national units.



Left: The Africa Exposure Map shows the geographic distribution of residential, commercial and industrial buildings. The number of buildings is presented on a hexagonal grid, with a spacing of 0.30 x 0.34 decimal degrees (approximately 1,000 km^2 at the equator).

Links

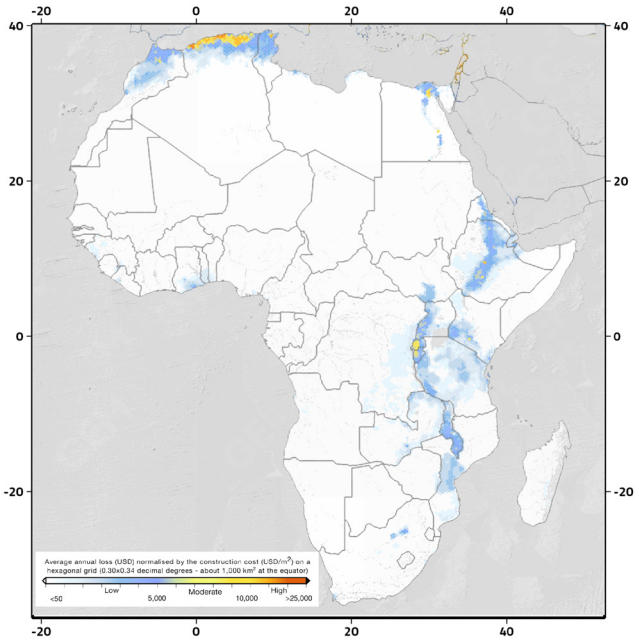
Documentation
https://s.gem.foundation/K9BP

Data Files
https://s.gem.foundation/K9BS

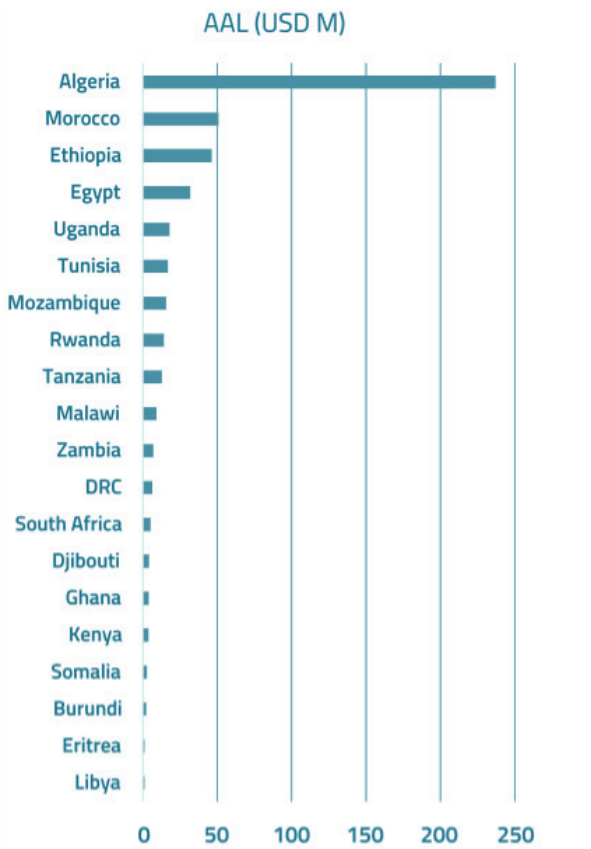
Interactive Map

Africa Risk
https://s.gem.foundation/K9Bj

Africa Exposure
https://s.gem.foundation/K9Bg



Above: Africa Seismic Risk Map shows the geographic distribution of average annual loss (USD) normalised by the average construction costs of the respective country (USD/m^2) due to ground shaking in the residential, commercial and industrial building stock components.



Above: Figures showing the top 20 countries in Africa in terms of average annual losses. GEM's OpenQuake-engine was used to estimate risk metrics for each country.

Application to the Sendai Seven indicators

GEM tools, datasets and other information for hazard and risk assessment are available for use by national governments and the public. Below are some examples of how our resources can be utilized to address the Sendai Seven indicators.

GLOBAL TARGETS A-E:

Reduced global disaster mortality, number of affected people, direct economic loss and disaster damage to critical infrastructure and disruption of basic services.

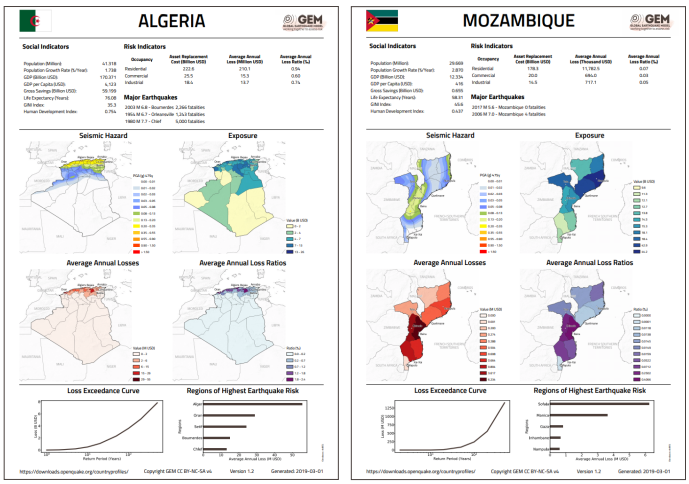
The GEM Africa Model fragility and vulnerability functions can be used directly in the assessment of economic and human losses due to earthquakes. Hazard and risk models for the rest of the world will also be released over the coming months.

Links

Country profiles
https://www.globalquakemodel.org/country-risk-profiles

Global maps
https://www.globalquakemodel.org/gem

OpenQuake
https://www.globalquakemodel.org/openquake



Above: Examples of country risk profile for Algeria and Mozambique developed by GEM. The profile consists of social and risk indicators including average annual losses and regions of highest seismic risk.

GLOBAL TARGET F (5 & 7):

Transfer and exchange of science, technology and innovation; and capacity-building initiatives in developing countries.

More than 550 individuals from various regions have participated in GEM workshops and trainings putting the knowledge and tools in the hands of local experts and partners.

Right: GEM officers, staff and partners during the closing ceremony of the Sub-Saharan Africa Hazard and Risk Assessment Project (SSAHARA), Addis Ababa, Ethiopia, 2015.

GLOBAL TARGET G:

Increase the availability of and access to disaster risk information and assessments to the people.

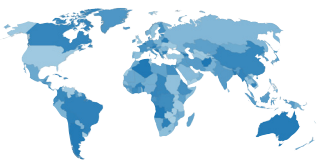
More than 5000 downloads of GEM's global earthquake hazard and risk maps have occurred since they were released in December 2018 (https://www.globalquakemodel.org/event-feedback).

The OpenQuake Platform had more than 25K users from 3.3K cities since 2015 (https://platform.openquake.org/).

GLOBAL MAPS

5K+

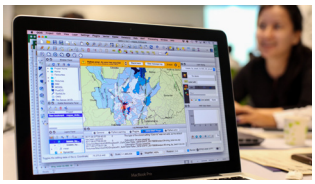
downloads



OQ PLATFORM

25K+

users



Let's work together

Partner with us and experience the benefits of GEM's comprehensive approach to seismic hazard and risk assessment including vulnerability, fragility and exposure modeling and pioneering efforts in social vulnerability and recovery. Download our brochure at: https://s.gem.foundation/K9Bz

For more detailed information on partnership options, visit:
https://www.globalquakemodel.org/get-involved or contact join@globalquakemodel.org.