

WHERE WE STAND AND OUR WAY FORWARD

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2016 Central Italy M6.0 earthquake (La Repubblica)

Modelling earthquake scenarios

GEM

Are the models capable of reproducing the observed consequences?

What are the weaknesses and strengths of the models?

What can we learn from the event?



Validation of seismic risk models

Validation of seismic risk models

Comparison between estimated and observed losses for 123 past events (1980-2017)

GEM Global Risk Model v2018



Observations from past earthquakes



Estimation of earthquake impact





How to estimate the earthquake impact from a past event?



- Collect information for historical events: from rupture and recording stations to impact
- Store modelling alternatives and observations
- Define and adjust the input models
- Improve information as new studies and methodologies become available

GEM



Information for **100** events in 32 countries

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لاً main → لاً 1 branch الا 0 tags CatalinaYepes Update contribute gu	delines.md	Go to file Add file - <> Code -	About இ GEM Earthquake Scenario Database
Albania/20191126_M6.4_Albania	Add events Albania Add events in Algeria	13 hours ago 14 hours ago	earthquakes openquake
Australia/19891227_M5.4_Newcastle Botswana/20170403_M6.5_Moijab	Add events NZ and AUS Add events in Africa Add events Chile	13 hours ago 13 hours ago 13 hours ago	☆ 0 stars ⊙ 7 watching 양 0 forks
Colombia	Add events Colombia Add events Costa_Rica	13 hours ago 13 hours ago	Releases No releases published
Croatia Cyprus/19961009_M6.8_Cyprus Ecuador/20160416_M7.8_Pedernales	Add events in Croatia and Serbia Add events in Cyprus Add events in Ecuador	13 hours ago 13 hours ago 13 hours ago	Packages
Egypt/19921012_M5.9_Cairo	Add events in Africa Add events in El Salvador	13 hours ago 13 hours ago	No packages published Publish your first package

Recording stations



Conditioning ground shaking on recorded station data

- OpenQuake implementation of the conditioning methodology proposed by Engler et al. (2022)
- User-adjustable input files
 - Rupture definition
 - Ground motion models (GMMs & GMICE)
 - Custom vs30 or site-amplification functions
 - Use of different models for the spatial cross-correlation of the within-event residuals and cross-correlation of the IMs for the between-event residuals
- Estimates for any Intensity Measure Type (IMT) supported by the selected GMM



Recording stations



GEM

2023 M7.8 Kahramanmaraș-Gaziantep, Turkey

Recording stations





Recording stations



2010 M7.0 Haiti

Recording stations



2010 M7.0 Haiti

GFM



2005 M7.6 Kashmir, Pakistan



Rupture details

atribute	description
Fault mecanism	Normal
Tectonic region type	Subduction Intraslab

Preferred nodal plane solution

source	longitude	latitude	depth	strike	dip	rake	mag
GCMT	-98.63	18.59	51	108.94	46	-97	7.1
GFZ	-98.49	18.56	50	103.94	49	-98	7.1
IPGP	-98.399	18.584	58	110.94	37	-91	7.1
JMA	-98.255	18.354	50	108.94	45	-96	7.1
Melgar_et_al_2018	-98.6878	18.3044	57.5	119.04	43.91	-82	7.1
SSN	-98.6712	18.3297	51.2	111.94	46	-93	7.1
USGS	-98.4887	18.5499	48	109.35	45.82	-93	7.1

Rupture figure



Recording stations

Ruptures

Ground motion fields

GROUND MOTION FIELDS USING OPENQUAKE

This folder includes the OpenQuake input files to generate scenario ground motion fields (gmfs) considering different sources of information:

1. From rupture.

From rupture and conditioned to recording stations (with only seismic stations or with seismic and macroseismic stations).
 From ShakeMap.

The following files are available:

- stationlist_seismic.csv: OpenQuake input file with past observations, considering only seismic stations. If no seismic stations are available for the event, the file is not reported.
- stationlist_all.csv : OpenQuake input file with past observations, considering seismic and macroseismic stations. If no macroseismic stations are available for the event, the file is not reported.
- site_model_stations.csv : OpenQuake input file with the site model (Vs30 values) at the location of the observations.
- site_model.csv : OpenQuake input file with the site model for which the ground shaking will be estimated.
- site_model.png : Figure of the site model (Vs30 based on USGS data).
- gmpe_logic_tree_*.xml : OpenQuake input file with the logic tree file for the ground motion model.
- job_stations_none.ini: Example of a configuration file (job.ini) for running OpenQuake calculations without conditioning the ground shaking to given observations.
- job_stations.ini: Example of a configuration file (job.ini) for running OpenQuake calculations when conditioning the ground shaking to given observations.





Distance to the rupture (rrup, km)

Which GMM better describes the ground shaking?

- A model derived for the specific region
- Models used in the national PSHA model
- Models used in regional PSHA models







Median ground motion fields

The following images present the median ground motion field for the combination of rupture and GMPE that generates the lowest **nominal bias** when conditioning the ground shaking to observations. The folder Sensitivity provides the summary of the sensitivity analysis carried out with the available ruptures and GMPEs.





Sensitivity analysis

The following information is available in the Sensitivity folder :

- calculation_summary.csv : Details on the calculations carried out in the sensitivity analysis.
- log_calc_*.txt : File with the OpenQuake running information in a .txt format. This file includes the nominal bias estimates for each GMPE present in the logic tree model.
- gmf_median_PGA_*.csv : Generated ground motion fields for PGA for a given calculation ID.

Metadata in file calculation_summary.csv

- calc_id : unique identifier for the calculation.
- description : details on the calculation
- cal_time : time of the calculation.
- recording_stations : "All" stations (seismic + macroseismic), or only "seismic" stations.
- gmlt : Ground Motion Logic Tree used in the calculation.
- rupture : Rupture model used in the calculation.
- gmpe : Ground Motion Prediction Equation (ground motion model).
- imt : Intensity measure type.
- max_gmv : Maximum ground motion value.
- nominal_bias_mean:
- nominal_bias_stdev : Standard deviation for the nominal_bias_mean .
- abs_bias : Absolute value of the nominal_bias_mean .



Name	Last commit	Last update
<u></u>		
Impact_All_ID_0.csv	Adjust DS definitions to EMS-98 and fix currency in insured I	2 months ago
B Impact_Buildings_Detailed.csv	Update Impact information at smaller ID levels	1 month ago
B Impact_Buildings_ID_1.csv	Update Impact information at smaller ID levels	1 month ago
Impact_Human_ID_1.csv	Update Impact information at smaller ID levels	1 month ago
Impact_Human_ID_2.csv	Update Impact information at smaller ID levels	1 month ago
M* README.md	README modification	1 day ago

README.md

IMPACT DATA COLLECTION

Information at different administrative levels is collected for the consequences of the event, which include building damage, economic losses, and human impact due to the earthquake and its induced effects.

The file Impact_All_ID_0.csv provides the national summary of consequences reported by multiple sources.

When information is available at finer resolutions, dedicated files for each administrative level available are generated for the building and human impact.

- Impact_Buildings_ID_n.csv : Damaged building data at administrative level n.
- Impact_Human_ID_n.csv : Data of human impact information at administrative level n.

Note: When available, building-level information is included.



 GEER_2017: Geotechnical Extreme Events Reconnaissance Association (GEER). Geotechnical engineering reconnaissance of the 19 September 2017 Mw 7.1 Puebla-Mexico city earthquake, version 2.0 2017. Report No. GEER 055-B. https://doi.org/10.18118/G6JD46. Last accessed May 2022.













Tamaulipas

Zacatecas

GMM: ParkerEtAl2020SSlab Rupture: Melgar *et al.* 2018 Max. PGA: 0.43g

GMM: Kanno2006Deep Rupture: Melgar *et al.* 2018 Max. PGA: 0.81g





Veracruz

Tamaulipas



Tlaxcala

Aelgar et al 2018

Puebla

Tamaulipas



0.10

0.05

0.02 -



PGA [g]

0.30



Country level impact Fatalities: 362-471

Destroyed units: 16-20 k Damaged units: +40-50 k Affected units: 150-190 k



Country level impact

Fatalities: 362-471 Destroyed units: 16-20 k Damaged units: +40-50 k Affected units: 150-190 k

Seismic stations	AbrahamsonEtAl 2015SSlab	ParkerEtAl 2020SSlab	Kanno 2006Deep
Max PGA	0.23 g	0.43 g	0.81 g
Completely damaged buildings	37 k	154 k	141 k

- Damaged units (buildings, dwellings, or households)
- Reported damage states
- Year of the event vs year of the exposure model *How to move forward or backwards*









EL_Salvador	Add events in El Salvador		GE	
Greece	Add events Greece		Contributors 2	
HPHe v2023.0.0 release for the GE	M ^r s ⁱ Earthidiaike Scenario Database is available! 😼 🚀		CatalinaYepes CatalinaYepesE	
THis repository is a collection of ear	thousake footprints and consequences from past events.		antonioettorre	
India/20110918_M6.9_Sikkim	Add events in South Asia			
ndones ia	onesiaAdd events in South Asia 3		Languages	
40 - Martiner Annual Annua	And Lunine frant State		Languages	
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Mexico	Add events Wexted	3 hours ago		
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New Zealand Add events NZ and AUS			Automatically convert CI/CD files to	
Pakistan/20051008_M7.6_Kashmir	Add events in South Asia	3 hours ago		
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► Table with available events_vra	able with available events manual 19900530_Sequence_Vra Add events in Netherlands and Romania		generator	
Model versions	Add events in Croatia and Serbia		Generate SLSA3 provenance for your existing release workflows	
Spain/20110511_M5.1_Lorca	Add events in Spain	3 hours ago		

Thank you!

