



PSHA input model documentation for Indonesia (IDN)

GEM Hazard Team

Version history

Table 1 summarises version history for the IDN input model, named according to the versioning system described [here](#), and indicating which version was used in each of the global maps produced since 2018. Refer to the [GEM Products Page](#) for information on which model versions are available for various use cases. The changelog describes the changes between consecutive versions and are additive for all versions with the same model year.

Table 1 – Version history for the IDN input model.

Version	2018.1	2019.1	2022.1	2023.1	Changelog
v2017.0.0	X	X	X		First version of the model implemented fully in OpenQuake.
v2017.1.0				X	Mmin extended to M4 for crustal distributed seismicity. gmmLT.xml updated with more recent GMPEs

The following text describes v2017.1.0.

Authors: M. Irsyam., L. Faizal, D. Natawidjaja, I. Meilano, S. Widiyantoro, W. Triyoso, A. Rudiyanto, S. Hidayati, M. Asrurifak, M. Ridwan, P. Cummins

1 Summary

The 2017 seismic hazard model for Indonesia was developed by the Team for Updating Seismic Hazard Maps of Indonesia of the National Center for Earthquake Studies, Indonesia. (Irsyam et al., 2017). The model builds on the experience collected throughout the last 15 years and on international collaborations notably with the United States Geological Survey (USGS) and Geoscience Australia. The model was originally produced partly using the NSHMP software of the USGS and partly in the [OpenQuake \(OQ\) engine](#). To achieve an entirely OQ implementation, part of the model has been translated from its original format into OQ.

2 Tectonic overview

Indonesia is one of the most tectonically complex nations on Earth. The majority of the country is on continental and transitional crust of Indochina, and many oceanic plates and microplates subduct under this more buoyant crust. A continuous subduction zone from offshore Myanmar to Papua forms the south and west border of the country, where crust of the Indian and Australian plate dives beneath Indonesia, creating great megathrust earthquakes as well as smaller, shallower faults and volcanoes in the upper plate that can be very hazardous. To the east, very complicate and poorly understood subduction systems also create the potential for damaging earthquakes throughout Sulawesi, the Moluccas, Papua, Timor and eastern Borneo, and the many smaller intervening isles.

3 Basic Datasets

See Irsyam et al. (2017) for a description of the datasets used for developing the hazard model.

4 Hazard Model

4.1 Seismic Source Characterisation

The seismic source characterisation (SSC) consists of various seismic source typologies to describe earthquake occurrence in different tectonic settings. Distributed seismicity is used to model both active shallow and deep intraslab seismicity, while fault sources are used to model seismicity occurring on shallow crustal faults and large subduction interface events.

The OQ implementation uses three OQ source typologies. The background (gridded) seismicity models are implemented as collections of **Point Sources**. Crustal faults are modelled using **Simple Fault Sources**, and subduction faults are modeled using **Complex Fault Sources**.

4.2 Ground Motion Characterisation

The table below shows the ground motion characterisation (GMC), which is comprised of a set of ground motion prediction equations (GMPEs). The GMM for the 2017 Indonesia model distinguishes between three main tectonic regions: *Active Shallow Crust*, *Subduction Interface*, and *Subduction Inslab*.

Epistemic Uncertainties For every tectonic region, epistemic uncertainty is considered by using multiple GMPEs, each with an associated logic tree weight.

Subduction Interface	Weight
AbrahamsonEtAl2015SInter	0.25
ParkerEtAl2020SInter	0.25
ZhaoEtAl2006SInter	0.25
KuehnEtAl2020SInter	0.25
Active Shallow Crust	Weight
BooreEtAl2014	0.2
CampbellBozorgnia2014	0.2
ChiouYoungs2014	0.2
CauzziEtAl2014	0.2
ZhaoEtAl2006Asc	0.2
Subduction Inslab	Weight
AbrahamsonEtAl2015SSlab	0.25
ParkerEtAl2020SSlab	0.25
ZhaoEtAl2006SSlab	0.25
KuehnEtAl2020SSlab	0.25

Table 2 – GMPEs used in the IDN model.

5 Results

Hazard curves were computed with the [OQ engine](#) for the following:

- Intensity measure types (IMTs): peak ground acceleration (PGA) and spectral acceleration (SA) at 0.2s, 0.3s, 0.6s, 1.0s, and 2s
- reference site conditions with shear wave velocity in the upper 30 meters (Vs30) of 760-800 m/s, as well as for Vs30 derived from a topography proxy (Allen and Wald, 2009)

Hazard maps were generated for each reference site condition-IMT pair for 10% and 2% probabilities of exceedance (POEs) in 50 yrs. Additionally, disaggregation by magnitude, distance, and epsilon was computed for the following cities: Jakarta, Bandar Seri Begawan and Dili. The results were produced as csv files and bar plots for each of the following combinations:

- hazard levels for 10% and 2% POE in 50 yrs
- PGA and SA at 0.2s, 0.3s, 0.6s, and 1.0s
- $V_{s30}=800$ m/s

All calculations used a ground motion sigma truncation of 5. Results were computed for sites with 6 km spacing

Visit the [GEM Interactive Viewer](#) to explore the Global Seismic Hazard Map values (PGA for $V_{s30}=800$ m/s, 10% poe in 50 years). For a comprehensive set of hazard and risk results, see the [GEM Products Page](#).

6 References

Allen, T. I., and Wald, D. J., 2009, On the use of high-resolution topographic data as a proxy for seismic site conditions V_{s30} , *Bulletin of the Seismological Society of America*, 99, no. 2A, 935-943

M. Irsyam, S. Widiyantoro, D. Natawidjaja, I. Meilano, A. Rudiyanto, S. Hidayati, W. Triyoso, N. R. Hanifa, D. Djarwadi, L. Faizal, Sunarjito (editor), Team for Updating of Seismic Hazard Maps of Indonesia 2017. 2017. *Earthquake Source and Hazard Maps of Indonesia 2017*. National Center for Earthquake Studies (PusGen), Research Center for Housing and Human Settlement, Directorate General for Research and Development, Ministry of Public Works and People Housing, ISBN 978-602-5489-01-3. (in Indonesian)

Irsyam, M., Natawidjaya D. H., Daryono M.R., Widiyantoro S., Asrurifak M., Meilano I., Triyoso W., Hidayati S., Rudiyanto A., Sabaruddin A., Faisal L. (2017). Development of new seismic hazard maps of Indonesia 2017. In *Proceedings of the 19th International Conference on Soil Mechanics and Geotechnical Engineering*, Seoul 2017.

Last processed: Thursday 8th June, 2023 @ 18:13

www.globalquakemodel.org

If you have any questions please contact the GEM Foundation Hazard Team at: hazard@globalquakemodel.org