PSHA input model documentation for Papua New Guinea (PNG)

GEM Hazard Team

Version history

Table 1 summarises version history for the PNG 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 PNG input model.*

Version	2018.1	2019.1	2022.1	2023.1	Changelog
v2015.0.0	X	X			First version of the model.
v2020.0.0			X		An updated version of the model, described in Ghasemi et al. (2020).
v2020.0.1				X	Mmin extended to M4 for crustal distributed seismicity. Source ids were revised to work with disaggregation by source.

The following text describes v2020.0.1.

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1 Summary

The seismic hazard model for Papua New Guinea (PNG) was developed by Geoscience Australia in close collaboration with the Rabaul Volcano Observatory, Port Morseby Geophysical Observatory and engineering geology branch of the Geohazards Management Division of the Papua New Guinea Department of Mineral Policy and Geohazards Management. PNG v2020.0.0 improved many aspects of the seismic hazard model as compared to its predecessor model (v2015.0.0), including the used of an updated and more extensive seismic catalogue, and more advanced modelling of individual faults at active microplate boundaries. The ground motion characterization has also been updated, considering more recent ground motion models.

The original construction of the model is compatible with the https://github.com/gem/oq-engine/.

2 Tectonic overview

The territory of Papua New Guinea is surrounded by active boundaries between three major tectonic plates and eight microplates. The three major plates are the northward moving Australian plate, and the WNW moving Caroline and Pacific plates. The convergence of these three major plates is mediated by combination of rotational and obliquely convergent motions of several micro plates. The complex interactions of these plates is responsible for the tectonic process and the pronounced seismic activity due to subduction, seafloor spreading, rifting and collisional orogenesis.

3 Basic Datasets

The seismic source characterisation is based on:

- a composite catalogue developed as part of the modelling process, which combines the International Seismological Centre (ISC) catalogue (events ranging 1900-2017), Global Centroid Moment Tensor catalogue (1976-2017), and the ISC-GEM catalogue (1904-2014).
- GNSS-based active faults data compiled by *Wallace et al. (2014)* and *Koulali et al., 2015)*.

For more details refer to *Ghasemi et al. (2020)*.

4 Hazard Model

4.1 Seismic Source Characterisation

The seismic source characterisation is based on earthquake location and rate information from the instrumental earthquake catalogue and neotectonic fault studies. The SSC includes:

- background seismicity is covered by gridded **point sources** with smoothed rates
- shallow crustal faults are modelled using **simple fault sources**
- subduction interfaces are modelled using **complex fault sources**.
- subduction intraslab sources are modelled using **point sources** that produce finite ruptures constrained to the slab volume

4.2 Ground Motion Characterisation

Table **??** shows the ground motion characterisation (GMC), which comprises a set of ground motion prediction equations (GMPEs) for each of the main tectonic regions.

Active Shallow Crust	**Weight**
CauzziEtAl2014	0.3
ChiouYoungs2014	0.3
ZhaoEtAl2016Asc	0.4
Subduction IntraSlab	**Weight**
ZhaoEtAl2016SSlab	0.5
AbrahamsonEtAl2015SSlab	0.5
Subduction Interface	**Weight**
AbrahamsonEtAl2015SInter	0.3
ZhaoEtAl2016SInter	0.3
AtkinsonBoore2003SInter	0.4

Table 2 *– GMPEs used in the PNG 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: Port Moresby. 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
- Vs30=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 Vs30=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 $Vs30$, Bulletin of the Seismological Society of America, 99, no. 2A, 935-943

Ghasemi, H., Cummins, P., Weatherill, G., McKee, C., Hazelwood, M., & Allen, T. (2020). Seismotectonic model and probabilistic seismic hazard assessment for Papua New Guinea. Bulletin of Earthquake Engineering, 18(15), 6571-6605.

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