PSHA input model documentation for Taiwan (TWN)

GEM Hazard Team

Version history

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

Version	2018.1	2019.1	2022.1	2023.1	Changelog
v2015.0.0	X	X			New version of the model developed by TEM. This version incorporates updated fault sources (with new geometry and some modelled as time-dependent), a revised area source and smoothed seismicity model computed using an updated earthquake catalog, and a new GMPE to model active shallow crustal seismicity. The hazard increases throughout the majority of the country, most notably in the east.
v2020.0.0			X		Source ids were revised to work with disaggregation by source. The ssmLT.xml has been rearranged for efficiency.

The following text describes v2020.0.0.

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1 Summary

Coverage of Taiwan is with the 2020 hazard model developed within the Taiwan Earthquake Model (TEM) initiative (*Chan et al., 2020*). The model was originally implemented for the OpenQuake (OQ) engine.

2 Tectonic overview

The island of Taiwan occupies a position along the convergent margin between the Philippine Sea Plate and the marginal plates of eastern Asia. The west-dipping Ryukyu Trench extends to the north to Japan, while the east-dipping Manila Trench runs south of the island to the Philippines. These systems come together in a bivergent thrust belt that cuts through the island, producing major reverse earthquakes on faults such as the Chelungpu Thrust.

3 Basic Datasets

Please refer to *Chan et al. (2020)* and *Shyu et al. (2020)*.

4 Hazard Model

4.1 Seismic Source Characterisation

The Taiwan hazard model includes the following seismic sources, modelled as the listed OpenQuake source typologies:

- Distribtued seismicity in active shallow crust, modelled in two equally weighted logic tree branches: **area sources** and smoothed seismicity modelled as **point sources**.
- crustal faults are modelled as **complex fault sources** with characteristic occurrence rates confined to a single magnitude bin.
- The Manila and Ryukyu-arc subduction interfaces were modelled as **simple faults** with characteristic occurrence rates. The Manila interface was divided into three segments.
- Intraslab earthquakes for both subduction zones are modeled as **simple faults** according to the subducting slab depth contours with truncated Gutenberg-Richter MFDs.

The sources are described in detail in *Chan et al. (2020)*.

4.2 Ground Motion Characterisation

Interface subduction zone	**Weight**
LinLee2008SInter	1.0
Active Shallow Crust	**Weight**
Lin2011foot	0.5
Lin2011hanging	0.5
Intraslab subduction zone	**Weight**
LinLee2008SSlab	1.0

Table 2 *– GMPEs used in the TWN 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: i, e, T, p and a. 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

Chan, Chung-Han, et al. "Probabilistic seismic hazard assessment for Taiwan: TEM PSHA2020." Earthquake Spectra 36.1_suppl (2020): 137-159.

Shyu, JBH, Y.-H. Yin, C.-H. Chen, Y.-R. Chuang, and S.-C. Liu (2020), Updates to the on-land seismic structure source database by the Taiwan Earthquake Model (TEM) project for seismic hazard analysis of Taiwan, Terrestrial, Atmospheric and Oceanic Sciences, 31(4), 469-478, doi:10.3319/tao.2020.06.08.01.

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