GLOBAL EARTHQUAKE MODEL
working together to assess risk

PSHA input model documentation for Korean Peninsula (KOR)

GEM Hazard Team

Version history

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

Version	2018.1	2019.1	2022.1	2023.1	Changelog
v2018.0.0	X	X			First version of the model, developed ad-hoc from existing models of nearby regions.
v2020.0.0			X		New model developed by GEM.
v2020.1.0				X	Mmin extended to M4 for crustal distributed seismicity. gmmLT.xml updated with more recent GMPEs. Source ids were revised to work with disaggregation by source.

The following text describes v2020.1.0.

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1 Summary

The KOR model was created by the GEM Secretariat. The model covers the entire Korean Peninsula, including North and South Korea.

2 Tectonic overview

The Korean Peninsula is not particularly tectonically active, and has few if any well-studied crustal faults. However, faulting around the peninsula, both in China and the Sea of Japan, may produce some ground shaking in the peninsula.

3 Basic datasets

The seismic source characterisation is based on local historical and instrumental catalogues and the available fault data, both based on *KIGAM (2012)*.

4 Hazard Model

4.1 Seismic Source Characterisation

This model includes shallow crust sources and subduction sources.

The shallow crustal seismicity is modelled as **area sources** and **fault sources**. The area sources use a logic tree with two hypotheses on the maximum possible magnitude, two branches for the completeness period of the catalogue and three different manners for inverting the recurrence parameters from the observed earthquake rates. To seismicity of the fault system located in the south-east of Korea is modelled using the seismic hazard and earthquake rate in fault systems (SHERIFS) method (Chartier et al., 2019), allowing complex multi-fault ruptures in the system. As these faults are poorly known, the logic tree includes three hypotheses for the slip-rate, three hypotheses for the possible rupture to be expected in this system, and two hypotheses on the share of on-fault versus off-fault seismicity in the region of the fault system.

The subduction sources were simply taken from the hazard model covering Japan as their impact on the hazard for Korea is minimal.

4.2 Ground Motion Characterisation

The ground motion models logic tree is built based on a selection of models by a panel of experts and published in a Korean report (*KIGAM, 2012*). This selection was then simplified because some of the selected GMPEs are not available in the OpenQuake engine.

Subduction IntraSlab - South West Correction	**Weight**
AbrahamsonEtAl2015SSlab	0.33
ZhaoEtAl2006SSlab	0.33
AtkinsonBoore2003SSlab	0.34
SSC	**Weight**
PezeshkEtAl2011NEHRPBC	0.5
AtkinsonBoore2006Modified2011	0.5
Subduction IntraSlab	**Weight**
AbrahamsonEtAl2015SSlab	0.33
ZhaoEtAl2006SSlab	0.33
AtkinsonBoore2003SSlab	0.34
Active Shallow Crust	**Weight**
ZhaoEtAl2006Asc	0.33
ChiouYoungs2014	0.33
AkkarEtAlRjb2014	0.34
Subduction Interface	**Weight**
ZhaoEtAl2006SInter	0.33
AtkinsonBoore2003SInter	0.34
AbrahamsonEtAl2015SInter	0.33

Table 2 *– GMPEs used in the KOR model.*

5 Comparison to other models

We obtain similar hazard levels on rock than the previously published model of *KIGAM (2012)* for most cities in Korea except for the cities located in the vicinity of the fault system where we get a higher hazard level.

6 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: LIST OF CITIES. 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.

7 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

Chartier, Thomas, Oona Scotti, and Hélène Lyon-Caen. "SHERIFS: Open-source code for computing earthquake rates in fault systems and constructing hazard models." Seismological Research Letters 90.4 (2019): 1678-1688. doi: 10.1785/0220180332

KIGAM (2012). "Active fault map and seismic hazard map (the 3rd year report) (in Korean)". In: NEMA-science-2009-24

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