PSHA input model documentation for Central Asia (CEA)

GEM Hazard Team

Version history

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

Version	2018.1	2019.1	2022.1	2023.1	Changelog
v2018.0.0	X	X	X		First version of the model implemented in the EMCA program.
v2018.1.0				X	gmmLT.xml updated with more recent GMPEs

The following text describes v2018.1.0.

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1 Summary

The Global Hazard Mosaic covereage of Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, and Turkmenistan) comes from the Earthquake Model Central Asia (EMCA; *Ullah et al., 2013* and www.emca-gem.org), a Global Earthquake Model regional program coordinated by the German Research Centre for Geosciences (GFZ). The model was originally developed for the OpenQuake (OQ) engine.

2 Tectonic overview

Central Asia is a transitional region between the northern ranges of the Indo-Asian, Iranian and Caucasian active orogenic belts and the stable Eurasian interior. Range-bounding thrust faults are present through the southern part of this area, and some very large strike-slip faults such as the Talas-Fergana fault in between the Tien Shan and Pamir ranges can extend for a great distance into the more stable areas to the north. Strain rates are moderately high for continental orogens in the area, though the distributed nature of the deformation means that slip rates on individual faults rarely exceeds a few mm/yr. Nonetheless, seismicity from the early instrumental period (late 1800s and early 1900s) and paleoseismologic studies indicate that large, slowly-slipping faults are capable of hosting great (M 7.5-8.3) earthquakes, which are fortunately infrequent.

3 Basic Datasets

Please refer to *Ullah et al., 2013*.

4 Hazard Model

4.1 Seismic Source Characterisation

The source model consists of a single logic tree branch using **area sources** that model seismicity at depths < 50 km. In some cases, "super zones" were required in order to include enough data to assign occurrence parameters.

4.2 Ground Motion Characterisation

The original publication (*Ullah et al., 2013*) computes hazard in terms of MSK-64 intensity. The ground motion model logic tree below was assembled by the GEM Secretariat.

Active Shallow Crust	**Weight**
AkkarEtAlRjb2014	0.2
ZhaoEtAl2006Asc	0.2
ChiouYoungs2014	0.2
CauzziEtAl2014	0.2
BooreEtAl2014	0.2
Stable Continental Region	**Weight**
PezeshkEtAl2011NEHRPBC	0.33
YenierAtkinson2015BSSA	0.34
AtkinsonBoore2006Modified2011	0.33

Table 2 *– GMPEs used in the CEA 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: Tashkent, Dushanbe, Nur-Sultan, Ashgabat and Bishkek. 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

Ullah, Shahid, Dino Bindi, Marco Pilz, Laurentiu Danciu, Graeme Weatherill, Elisa Zuccolo, A. Issuk, N. Mikhailova, Kanat Abdrakhmatov, and Stefano Parolai. “Probabilistic seismic hazard assessment for Central Asia.” Ann. Geophys. 58, no. 1 (2015): 0103S.

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