The 2007 USGS Alaska Seismic Hazard Model

The 2007 USGS Alaska seismic hazard model is described by Wesson et. al. (2007) (see also the USGS Website). Here we present a short description of the OpenQuake-engine implementation of the model.

The Seismic Source Model

The seismic source model consists of different seismic source typologies to describe earthquake occurrence in different tectonic settings. The model defines gridded seismicity to model both active shallow and deep intraslab seismicity. Fault sources are instead defined for shallow crustal faults and large subduction interface events. Gridded seismicity models are implemented as collections of NRML pointSource objects. Crustal faults and subduction faults are instead modeled as NRML simpleFaultSource and NRML complexFaultSource objects, respectively.

The whole source model is divided into the following sub-models:

- Active shallow crust gridded seismicity
- Subduction intraslab gridded seismcity
- Active shallow crust faults
- Subduction interface faults

The map below depicts the annual occurrence rate per source (between minimum and maximum magnitudes) for the different source models included in the hazard model. Click the *show map layers* icon to view different source models and base layer maps.

Total occurrence rate
(number of events / year)

- < 1e-6
- 1e-6 - 1e-5
- 1e-5 - 1e-4
- 1e-4 - 1e-3
- 1e-3 - 1e-2
- 1e-2 - 1e-1
- 1e-1 - 1
- 1 - 10
- >= 10

.my-legend .legend-title { text-align: left; margin-bottom: 5px; font-weight: bold; font-size: 80%; } .my-legend .legend-scale ul { margin: 0; margin-bottom: 5px; padding: 0; float: left; list-style: none; } .my-legend .legend-scale ul li { font-size: 80%; list-style: none; margin-left: 0; line-height: 18px; margin-bottom: 2px; } .my-legend ul.legend-labels li span { display: block; float: left; height: 16px; width: 30px; margin-right: 5px; margin-left: 0; border: 1px solid #999; } .my-legend .legend-source { font-size: 70%; color: #999; clear: both; } .my-legend a { color: #777; }

The Ground Motion Model

The ground motion model distinguishes between three main tectonic regions:

- Active Shallow Crust
- Subduction Interface
- Subduction Intraslab

For each tectonic region, the model considers multiple ground motion prediction equations organized in a logic tree structure.

Active Shallow Crust	**Weight**
Boore et. al. 1997	0.25
Sadigh et. al. 1997	0.25
Abrahamson and Silva 1997	0.25
Campbell and Bozorgnia 2003	0.25

Subduction Interface	**Weight**
Youngs et. al. 1997	0.5
Sadigh et. al. 1997	0.5

Subduction Intraslab	**Weight**
Youngs et. al. 1997	0.5
Atkinson and Boore 2003	0.5

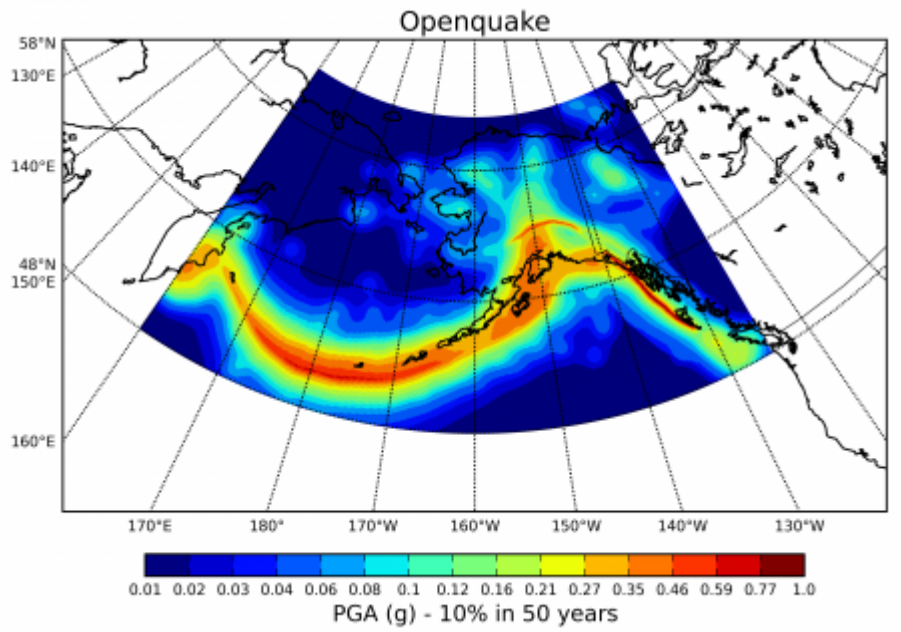
Reference site condition

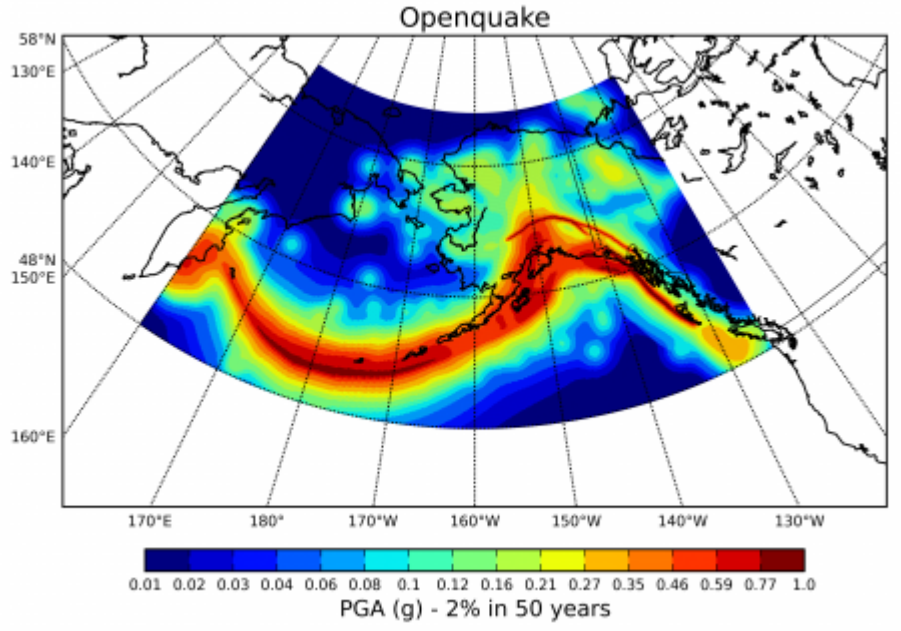
The NEHRP B/C site condition is assumed to be the reference site conditions for the 2007 Alaska National Seismic Hazard Model. This is equivalent to a Vs30 (shear wave velocity in the uppermost 30 meters) = 760 m/s. GMPEs that do not depend on Vs30 are used with coefficients corrected for the B/C site condition.

Hazard Results

Hazard maps

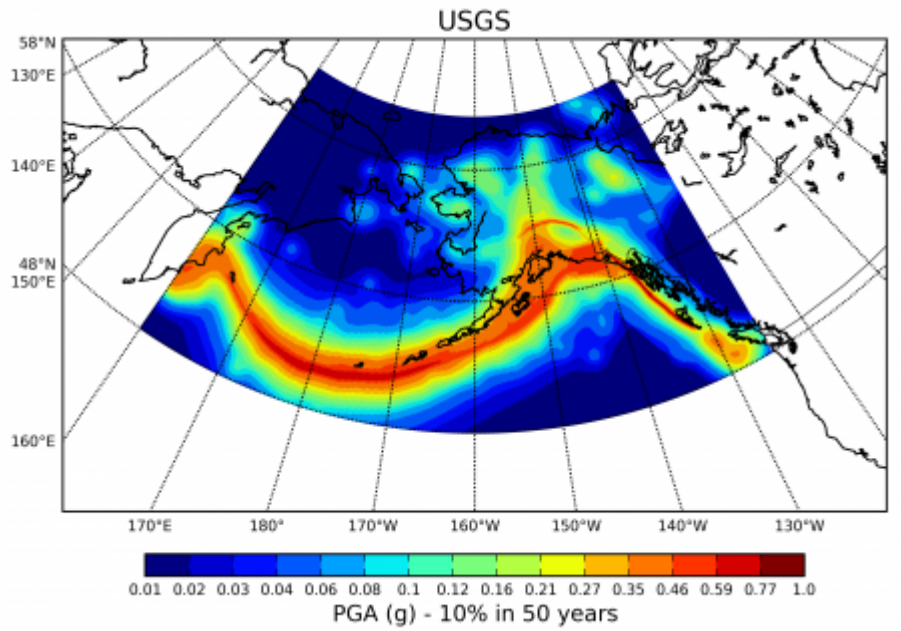
The figures below represent hazard maps for peak ground acceleration, for 10% and 2% probabilities of exceedance in 50 years , using the OpenQuake-engine.

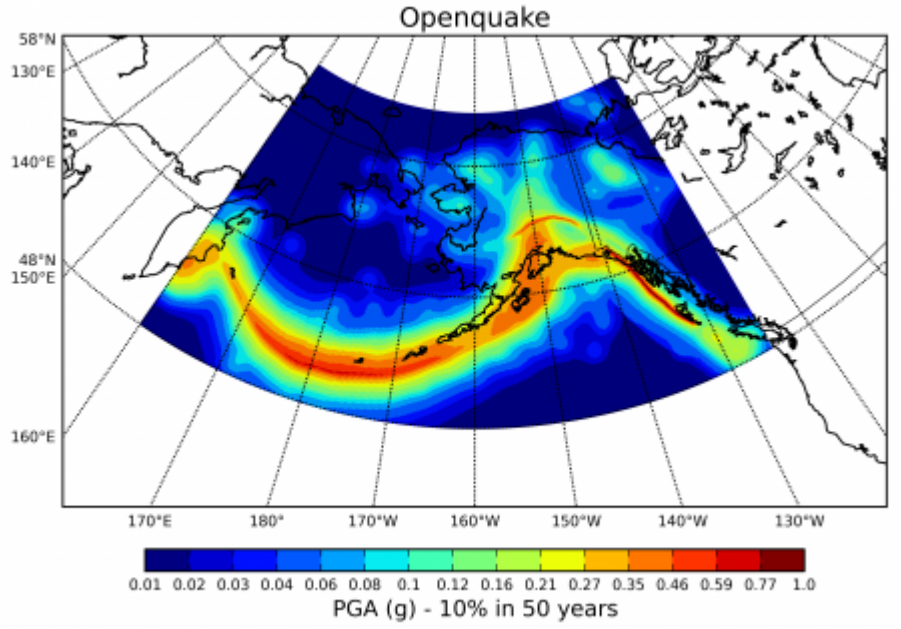


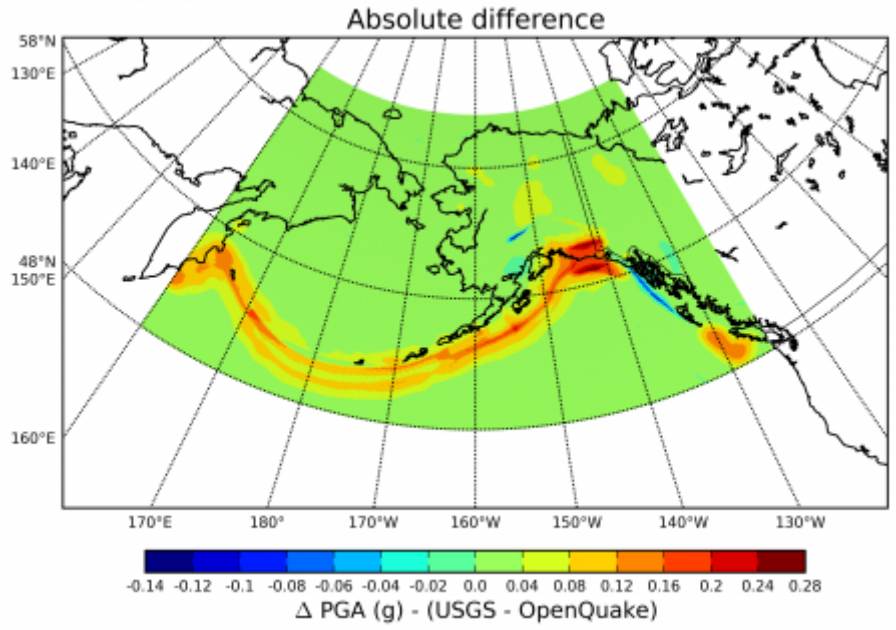


Comparison against USGS results

The figures below shows hazard maps, for 10% probability of exceedance in 50 years, provided by the USGS and computed with the OpenQuake-engine. A difference map is also shown which allows to more quantitatively appreciate the differences between the two maps. The largest differences are associated with subduction fault sources. Differences may be due to different approaches in modeling earthquake ruptures in complex geometries and magnitude scaling relationships. Further analysis is required to better constrain what are the sources of the discrepancies.


USGS
58°N
130°E
140°E
48°N
150°E
160°E
170°E
180°
170°W
160°W
150°W
140°W
130°W
0.01 0.02 0.03 0.04 0.06 0.08 0.1 0.12 0.16 0.21 0.27 0.35 0.46 0.59 0.77 1.0
PGA (g) - 10% in 50 years


Openquake
58°N
130°E
140°E
48°N
150°E
160°E
170°E
180°
170°W
160°W
150°W
140°W
130°W
0.01 0.02 0.03 0.04 0.06 0.08 0.1 0.12 0.16 0.21 0.27 0.35 0.46 0.59 0.77 1.0
PGA (g) - 10% in 50 years


Absolute difference
58°N
130°E
140°E
48°N
150°E
160°E
170°E
180°
170°W
160°W
150°W
140°W
130°W
-0.14 -0.12 -0.1 -0.08 -0.06 -0.04 -0.02 0.0 0.04 0.08 0.12 0.16 0.2 0.24 0.28
Δ PGA (g) - (USGS - OpenQuake)

References

- Wesson, Robert L., Boyd, Oliver S., Mueller, Charles S., Bufe, Charles G., Frankel, Arthur D., Petersen, Mark D., 2007, Revision of time-Independent probabilistic seismic hazard maps for Alaska: U.S. Geological Survey Open-File Report 2007-1043. Report

Model Summary Table

This table summarises the main characteristics of the original implementation of this model

1	**Datasets availability**	
1.1	Earthquake catalogue	Not available. The catalogue used to develop the model is a combination of several catalogues including the Centennial, PDE, ISC and Alaska Earthquake Information Center
1.2	Geological database	Not available. Information comes from different sources (see Wesson et al., 2007 page 12). A good description of major fault is included in the report.
1.3	Strong-motion database	Not available
1.4	Site characterization database	Not available
Notes		
2	**Methodology for model development**	
2.1	Scientific participation (SSHAC levels) and review process	Level 2
2.2	Documentation describing model preparation	Wesson et. al. (2007) provides a general description of the methodology adopted for the creation of the hazard model.
2.3	Codes used for model preparation	Not available
Notes		
3	**PSHA input model**	
3.1	**Seismic Source Model**	
3.1.1	Area sources	Not included
3.1.2	Grid sources	Gridded seismicity is used to model distributed seismicity in the shallow active crust as well as to model inslab seismicity
3.1.3	Crustal faults	Included
3.1.4	Subduction faults	Subduction interface sources modelled as a faults
3.1.5	Non-parametric ruptures	Not included
3.1.6	Magnitude-area scaling relationships	Not explicitly defined in Wesson et. al. (2007)
3.2	**Ground Motion Model**	
3.2.0	Tectonic regionalisation	Sources are classified in accordance with the same tectonic regions used by the USGS to compute hazard for the conterminous United States.
3.2.1	Models for active shallow seismicity	Included
3.2.2	Models for subduction interface	Included
3.2.3	Models for subduction intraslab	Included
3.2.4	Models for stable continental regions	Not included

3.2.5	Models for deep non-subduction sources	Not included
3.2.6	Models for volcanic areas	Not included
3.3	**Site Response Model**	
3.3.1	Based on GMPEs	Yes, hazard is computed for a reference soil condition corresponding to NEHRP B/C boundary (Vs30=760 m/s)
3.3.2	Based on site-response analysis	No
3.4	**Epistemic uncertainties**	
3.4.1	Seismic Source Model	Not included
3.4.2	Ground Motion Model	Included using a logic tree (see the ground motion model section)
3.4.3	Site Response Model	Not included
Notes		
4	**Hazard Input Description**	
4.1	Hazard input document	Not available
4.2	Original input files	Available (ASCII input files for the USGS fortran codes)
Notes		
5	**Calculation**	
5.1	Software	Suite of fortran codes developed by the USGS
5.2	**Results**	
5.2.1	Hazard curves	Not directly available
5.2.2	Hazard maps	Not directly available
5.2.3	Uniform hazard spectra	Not directly available
5.2.4	Disaggregation	Not directly available
5.2.5	Stochastic event sets	Not available
5.2.6	Ground motion fields	Not available
Notes	Almost all the results of a Classical PSHA can be computed with the USGS fortran codes	

Download The OpenQuake-engine Input Model

The OpenQuake-engine input model (NRML format) can be downloaded at the link provided below - Please read the license and disclaimer attached to the model.

N.B. This is a model adapted by GEM Hazard Team to the OpenQuake-engine from the original model developed by the USGS. This explains minor differences you might encounter between the results presented in the OpenQuake platform and those disseminated by the original Organisation.

Download