OR/19/038 Data

Jump to navigation Jump to search

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In this section, I describe briefly the source zone model for the British Isles developed by Musson and Sargeant (2007)[1] that is the basis for comparing the two software packages.

The UK source zone model was used to produce the most recent UK national hazard maps for the building code Eurocode 8 (Musson and Sargeant, 2007[1]). The model, which consists of 23 source zones, is strongly based on the tectonics and kinematics of the UK and less influenced by the seismicity distribution (Figure 2). It also includes the Viking Graben and associated structures as a single zone but excludes some parts of Scotland, extreme north-east of England, the Isle of Man, Northern Ireland, and the offshore area around the UK due to the low seismicity level (Musson and Sargeant, 2007[1]). The site for performing most hazard calculations has been chosen arbitrarily and is situated in the city of Manchester, i.e. 52.48°N and -1.89°E. However, I will also discuss the hazard curves determined for various other sites in the UK (Figure 2).

The Gutenberg-Richter recurrence law for the UK source model was computed using the penalised maximum likelihood in Johnston et al. (1994)[2] and modified by Musson (2011)[3]. It maximizes the information provided by different time windows of the earthquake catalogue for different magnitude completeness thresholds and allows a prior value to constrain the b-value (i.e the proportion of large events to small ones) in zones where there are few earthquakes. Using this method, Musson and Sargeant (2007)[1] compute the recurrence statistics for the individual source zones of the UK model. The activity rate a (a function of the total number of earthquakes in the sample) and the b-value of each source zone are expressed by a pdf and discretized by 25 pairs of the recurrence parameters with associated weights. Figure 3 shows an example of the probability distribution for the source zone EC9M and Table 3 shows the most likely value of the recurrence parameters in the distribution of the source zones.

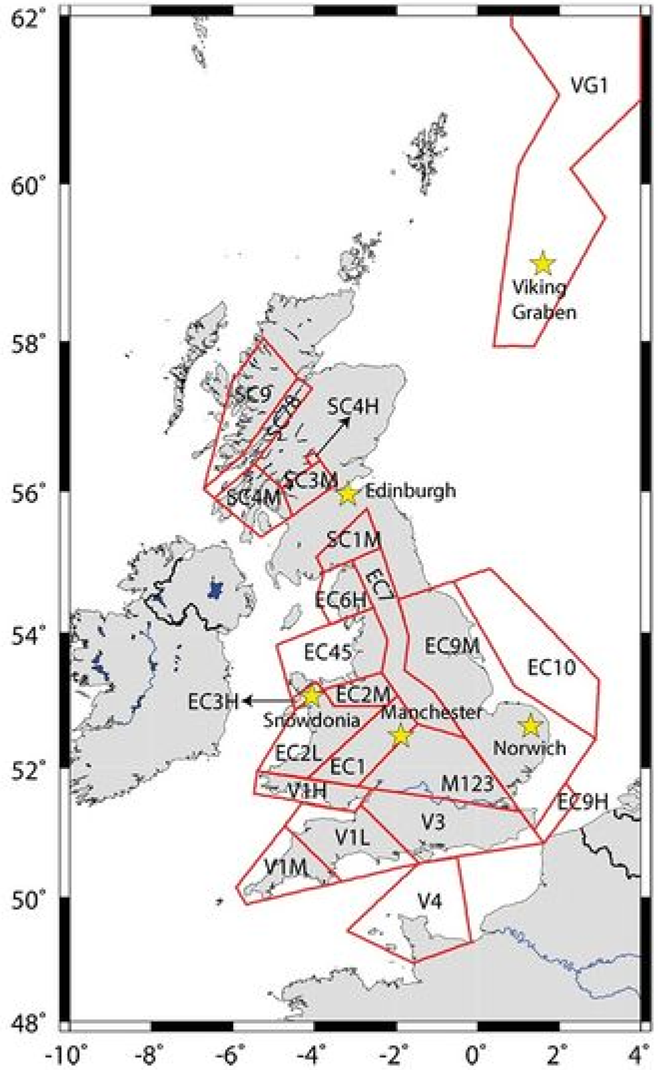

Figure 2 Source zone model of the UK from Musson and Sargeant (2007). It consists of 23 zones and the yellow stars indicate various sites.

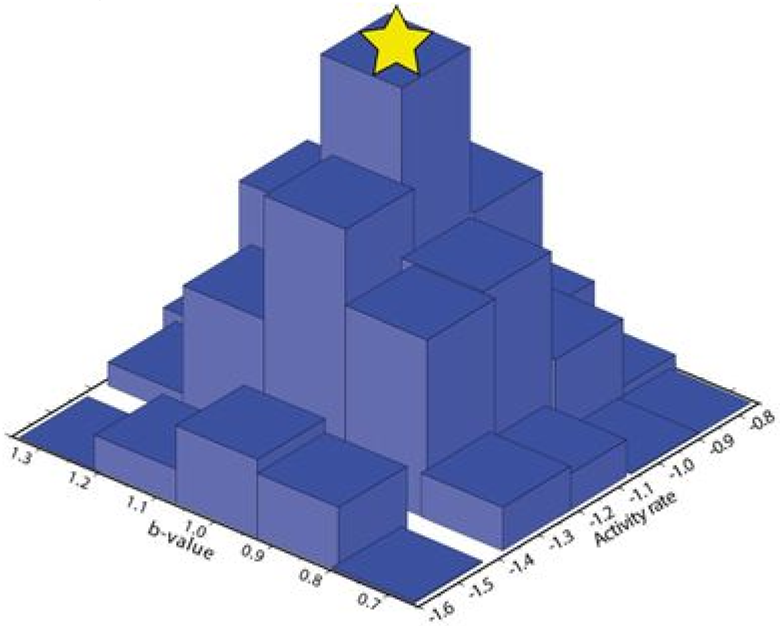

Figure 3 Probability density function for the activity rate and the b-value of the source zone EC9M of the UK source model. The star indicates the most likely value for the

recurrence parameters (a = -1.15 and b = 1.00).

Table 3 Activity rate with respect to 3.0 Mw and b-value for the 23 source zones of the UK model. The recurrence parameters were estimated using the penalized maximum likelihood procedure of Johnston et al. (1994)[2].

	Activity rate	***b*-value**		Activity rate	***b*-value**
SC1M	-1.93	1.00	EC7	-0.71	0.90
SC3M	-1.11	1.00	EC9H	-1.41	0.85
SC4H	-1.37	0.96	EC9M	-1.15	1.00
SC4M	-1.02	1.03	EC10	-0.82	1.01
SC78	-0.84	1.03	M123	-1.90	1.00
SC9	-0.83	1.09	V1H	-1.15	0.81
EC1	-0.92	0.92	V1M	-0.98	1.06
EC2M	-1.43	1.06	V1L	-1.11	1.00
EC2L	-1.62	1.00	V3	-1.64	0.98
EC3H	-1.36	0.85	V4	-1.01	0.77
EC45	-1.09	1.01	VG1	0.07	1.07
EC6H	-1.65	0.97			

Although the user can include a large number of recurrence parameters in the input file for OpenQuake and therefore construct a logic tree with many branches, it will end up in a lengthy file and a huge logic tree, consisting of 25 recurrence parameters multiplied by the 23 source zones multiplied by the branches from other parameters (e.g. GMPEs and maximum magnitude).

Maximum magnitude (Mmax) in the UK source model is defined by two logic trees, depending on whether the source zone is offshore or onshore (Table 4). The minimum magnitude that is the magnitude of the smallest earthquakes considered to be of engineering significance is chosen to be 4.5 Mw. Table 5 shows the depth distribution. For all source zones, the faulting is associated with a strike-slip focal mechanism with equal probability of having either a north-south or east-west orientation (Musson and Sargeant, 2007[1]).

To check whether the implementation of the GMPEs in M3C and OpenQuake provides similar hazard results in spite of the differences in the engine, I test many ground motion models, each associated with a weight of 1.0, as well as a combination of them in a weighted logic tree. I have chosen GMPEs that are commonly used for seismic hazard studies in the UK and worldwide, including Akkar et al. (2013)[4], Boore et al. (2014)[5], Abrahamson et al. (2014)[6], and Chiou and Youngs (2014)[7]. However, in most tests described in the next section, I use the ground motion model of Boore et al. (2014)[5] that is from the ‘Next Generation Attenuation 2’ project conducted by PEER in the western United States (Bozorgnia et al., 2014[8]). I applied a ground motion truncation of 3σ to the hazard calculations.

The site condition is assumed to be class B of the NEHRP (1994)[9] classification. I, therefore, assign a VS30 value (i.e. average shear wave velocity in the top 30 m) of 760 m/s.

Table 4 Distribution of the maximum magnitude of the UK model, together with their weight.

Mmax	**Weight (onshore)**	**Weight (offshore)**
5.5	0.20	-
6.0	0.50	0.60

6.5	0.30	0.40

Table 5 Distribution of the focal depth of the UK model, together with their weight.

Depth [km]	Weight
5	0.10
10	0.25
15	0.40
20	0.25

References

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Category:

- OR/19/038 Comparing seismic hazard software packages: M3C vs. OpenQuake

Navigation menu

Personal tools

- Not logged in
- Talk
- Contributions

- Log in
- Request account

Namespaces

- Page
- Discussion

☐

Variants

Views

- Read
- Edit
- View history
- PDF Export

☐

More

Search

Search Go

Navigation

- Main page
- Recent changes
- Random page
- Help about MediaWiki

Tools

- What links here
- Related changes
- Special pages
- Permanent link
- Page information
- Cite this page
- Browse properties

- This page was last modified on 2 December 2019, at 11:58.