

Seismic ground motion relationships in southern China based on stochastic finite-fault model

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Abstract: The characteristics of seismic ground motions in southern China are difficult to determine statistically due to a lack of strong ground motion data. In this study, a stochastic finite-fault ground motion model was adopted to simulate the seismic ground motions at bedrock for southern China, based on parameters derived from small and medium earthquakes that have occurred in the region. From these, the response spectra was estimated. A set of ground motion attenuation relationships was then developed based on simulated peak ground motions and response spectral parameters through regression, which would be applicable for use in engineering practice. Through comparisons, it was demonstrated that the proposed ground motion relationships are generally consistent with those obtained from other reported ground motion attenuation models for southern China.

Keywords: Stochastic finite-fault model; ground motion relationships; southern China

Appendix A

Simulated ground motions for bedrock in southern China*

M	R (km)	PSA (g) for Frequencies (Hz)										PGA (g)	PGV (m/s)
		0.1	0.2	0.32	0.5	1.0	2.0	3.2	5.0	10.0	20.0		
8.5	1.0	-2.761	-1.902	-1.450	-1.100	-.651	-.214	.049	.293	.602	.816	.064	4.262
8.5	1.0	-2.761	-1.902	-1.450	-1.100	-.651	-.214	.049	.293	.602	.816	.064	4.262
8.5	2.0	-2.763	-1.907	-1.455	-1.104	-.656	-.220	.043	.287	.597	.812	.057	4.256
8.5	3.0	-2.767	-1.916	-1.464	-1.112	-.666	-.227	.033	.276	.588	.803	.045	4.246
8.5	4.0	-2.779	-1.925	-1.477	-1.125	-.681	-.239	.021	.264	.574	.788	.028	4.234
8.5	5.0	-2.795	-1.939	-1.491	-1.141	-.695	-.253	.010	.252	.557	.769	.008	4.216
8.5	6.0	-2.819	-1.953	-1.509	-1.160	-.712	-.272	-.006	.232	.542	.750	-.017	4.196
8.5	7.0	-2.848	-1.975	-1.530	-1.175	-.733	-.291	-.023	.205	.521	.729	-.044	4.180
8.5	8.0	-2.877	-2.011	-1.554	-1.199	-.757	-.312	-.043	.180	.495	.701	-.077	4.160
8.5	9.0	-2.881	-2.042	-1.583	-1.230	-.791	-.339	-.071	.156	.468	.675	-.106	4.133
8.5	10.0	-2.915	-2.073	-1.607	-1.264	-.827	-.365	-.106	.131	.438	.644	-.142	4.099
8.5	12.0	-3.000	-2.118	-1.673	-1.324	-.859	-.438	-.175	.071	.376	.574	-.214	4.019
8.5	15.0	-3.077	-2.188	-1.754	-1.415	-.954	-.537	-.268	-.033	.248	.457	-.329	3.941
8.5	20.0	-3.232	-2.346	-1.918	-1.546	-1.092	-.696	-.435	-.213	.078	.244	-.538	3.773
8.5	25.0	-3.350	-2.495	-2.057	-1.708	-1.259	-.854	-.599	-.368	-.102	.051	-.739	3.646
8.5	30.0	-3.516	-2.651	-2.202	-1.845	-1.395	-.989	-.737	-.524	-.261	-.125	-.943	3.486
8.5	35.0	-3.598	-2.733	-2.313	-1.986	-1.539	-1.116	-.871	-.653	-.408	-.303	-1.110	3.380
8.5	40.0	-3.773	-2.861	-2.441	-2.087	-1.650	-1.238	-1.010	-.809	-.581	-.490	-1.295	3.246
8.5	50.0	-3.777	-2.895	-2.482	-2.143	-1.703	-1.322	-1.094	-.887	-.695	-.648	-1.445	3.197
8.5	60.0	-3.769	-2.923	-2.491	-2.169	-1.718	-1.354	-1.135	-.940	-.779	-.772	-1.547	3.181
8.5	70.0	-3.781	-2.931	-2.509	-2.187	-1.750	-1.363	-1.176	-.998	-.854	-.909	-1.653	3.178
8.5	80.0	-3.781	-2.894	-2.514	-2.178	-1.745	-1.387	-1.201	-1.050	-.948	-1.025	-1.741	3.179
8.5	90.0	-3.792	-2.931	-2.537	-2.195	-1.786	-1.439	-1.272	-1.108	-1.027	-1.152	-1.826	3.128
8.5	100.0	-3.785	-2.955	-2.548	-2.210	-1.800	-1.483	-1.310	-1.170	-1.107	-1.273	-1.911	3.122
8.5	110.0	-3.868	-2.994	-2.565	-2.278	-1.878	-1.553	-1.390	-1.268	-1.226	-1.446	-2.037	3.062
8.5	120.0	-3.913	-3.043	-2.647	-2.340	-1.945	-1.632	-1.471	-1.364	-1.374	-1.596	-2.142	3.009
8.5	130.0	-3.961	-3.115	-2.704	-2.401	-2.008	-1.688	-1.551	-1.446	-1.497	-1.751	-2.256	2.956
8.5	140.0	-3.985	-3.152	-2.750	-2.432	-2.046	-1.780	-1.610	-1.550	-1.604	-1.887	-2.341	2.909
8.5	150.0	-4.016	-3.195	-2.779	-2.508	-2.119	-1.821	-1.703	-1.639	-1.719	-2.011	-2.434	2.871
8.5	200.0	-4.204	-3.370	-2.976	-2.685	-2.344	-2.114	-2.032	-2.037	-2.234	-2.587	-2.820	2.668
7.5	1.0	-3.978	-2.831	-2.163	-1.701	-1.060	-.553	-.252	.016	.359	.610	-.119	3.628
7.5	2.0	-3.995	-2.843	-2.175	-1.707	-1.073	-.574	-.265	.009	.346	.591	-.140	3.621
7.5	3.0	-4.016	-2.866	-2.179	-1.715	-1.092	-.602	-.285	-.008	.325	.568	-.155	3.608
7.5	4.0	-4.027	-2.874	-2.190	-1.724	-1.115	-.631	-.314	-.032	.305	.542	-.186	3.596

7.5	5.0	-4.048	-2.893	-2.227	-1.750	-1.138	-.652	-.350	-.063	.275	.516	-.227	3.586
7.5	6.0	-4.083	-2.910	-2.256	-1.778	-1.170	-.686	-.391	-.104	.234	.477	-.264	3.559
7.5	7.0	-4.130	-2.927	-2.292	-1.805	-1.220	-.724	-.427	-.157	.171	.437	-.301	3.522
7.5	8.0	-4.122	-2.962	-2.317	-1.841	-1.264	-.772	-.454	-.195	.141	.399	-.348	3.480
7.5	9.0	-4.169	-3.043	-2.358	-1.904	-1.285	-.788	-.501	-.234	.093	.344	-.397	3.430
7.5	10.0	-4.255	-3.073	-2.394	-1.909	-1.329	-.833	-.548	-.276	.072	.290	-.453	3.380
7.5	12.0	-4.335	-3.167	-2.505	-2.035	-1.429	-.916	-.633	-.366	-.043	.194	-.576	3.273
7.5	15.0	-4.427	-3.277	-2.634	-2.121	-1.546	-1.051	-.760	-.521	-.182	.044	-.726	3.168
7.5	20.0	-4.652	-3.490	-2.823	-2.349	-1.771	-1.268	-.979	-.728	-.434	-.230	-1.007	2.941
7.5	25.0	-4.801	-3.656	-3.026	-2.529	-1.950	-1.449	-1.177	-.920	-.655	-.464	-1.246	2.753
7.5	30.0	-4.983	-3.809	-3.177	-2.669	-2.119	-1.617	-1.352	-1.124	-.837	-.686	-1.471	2.612
7.5	35.0	-5.140	-3.985	-3.333	-2.844	-2.246	-1.773	-1.521	-1.282	-1.010	-.883	-1.667	2.435
7.5	40.0	-5.248	-4.121	-3.464	-2.968	-2.413	-1.934	-1.648	-1.420	-1.184	-1.052	-1.868	2.287
7.5	50.0	-5.306	-4.164	-3.560	-3.073	-2.484	-2.005	-1.783	-1.562	-1.345	-1.272	-2.064	2.206
7.5	60.0	-5.323	-4.185	-3.540	-3.067	-2.501	-2.058	-1.803	-1.601	-1.429	-1.409	-2.190	2.201
7.5	70.0	-5.354	-4.188	-3.547	-3.054	-2.533	-2.083	-1.845	-1.665	-1.522	-1.539	-2.299	2.165
7.5	80.0	-5.365	-4.202	-3.561	-3.063	-2.554	-2.126	-1.906	-1.741	-1.623	-1.683	-2.407	2.155
7.5	90.0	-5.340	-4.210	-3.575	-3.098	-2.577	-2.158	-1.941	-1.795	-1.691	-1.799	-2.486	2.134
7.5	100.0	-5.372	-4.248	-3.602	-3.132	-2.627	-2.194	-1.979	-1.870	-1.791	-1.923	-2.590	2.089
7.5	110.0	-5.388	-4.289	-3.648	-3.218	-2.669	-2.290	-2.084	-1.948	-1.932	-2.101	-2.707	2.013
7.5	120.0	-5.466	-4.336	-3.691	-3.262	-2.737	-2.348	-2.183	-2.063	-2.052	-2.252	-2.836	1.954
7.5	130.0	-5.499	-4.396	-3.759	-3.302	-2.809	-2.418	-2.262	-2.152	-2.170	-2.421	-2.939	1.916
7.5	140.0	-5.569	-4.430	-3.811	-3.339	-2.836	-2.476	-2.335	-2.250	-2.293	-2.573	-3.047	1.846
7.5	150.0	-5.565	-4.485	-3.852	-3.400	-2.910	-2.564	-2.402	-2.339	-2.399	-2.707	-3.151	1.797
7.5	200.0	-5.718	-4.637	-4.050	-3.623	-3.156	-2.877	-2.786	-2.756	-2.951	-3.313	-3.566	1.572
6.5	1.0	-5.543	-4.210	-3.354	-2.648	-1.701	-1.000	-.685	-.375	.008	.324	-.385	2.914
6.5	2.0	-5.560	-4.214	-3.373	-2.654	-1.748	-1.059	-.715	-.390	-.002	.273	-.417	2.888
6.5	3.0	-5.613	-4.238	-3.437	-2.726	-1.776	-1.114	-.728	-.442	-.024	.252	-.457	2.831
6.5	4.0	-5.610	-4.268	-3.456	-2.729	-1.796	-1.169	-.790	-.473	-.097	.182	-.512	2.813
6.5	5.0	-5.693	-4.340	-3.514	-2.795	-1.883	-1.177	-.833	-.537	-.133	.129	-.592	2.740
6.5	6.0	-5.726	-4.386	-3.554	-2.861	-1.949	-1.271	-.939	-.596	-.206	.077	-.661	2.657
6.5	7.0	-5.801	-4.476	-3.669	-2.942	-1.999	-1.306	-.973	-.676	-.310	.002	-.726	2.600
6.5	8.0	-5.838	-4.504	-3.686	-2.988	-2.083	-1.366	-1.024	-.731	-.344	-.071	-.802	2.541
6.5	9.0	-5.914	-4.574	-3.752	-3.056	-2.113	-1.451	-1.109	-.784	-.414	-.150	-.882	2.510
6.5	10.0	-5.972	-4.623	-3.810	-3.127	-2.217	-1.517	-1.151	-.860	-.488	-.216	-.950	2.417
6.5	12.0	-6.069	-4.724	-3.906	-3.199	-2.305	-1.647	-1.284	-.993	-.608	-.366	-1.092	2.297
6.5	15.0	-6.273	-4.894	-4.084	-3.406	-2.467	-1.803	-1.456	-1.166	-.812	-.559	-1.302	2.120
6.5	20.0	-6.488	-5.129	-4.327	-3.641	-2.706	-2.025	-1.707	-1.428	-1.080	-.858	-1.623	1.889
6.5	25.0	-6.712	-5.356	-4.543	-3.841	-2.912	-2.269	-1.917	-1.640	-1.316	-1.129	-1.905	1.656
6.5	30.0	-6.852	-5.500	-4.696	-4.005	-3.108	-2.434	-2.110	-1.845	-1.532	-1.356	-2.156	1.482
6.5	35.0	-7.003	-5.675	-4.820	-4.180	-3.243	-2.594	-2.263	-2.017	-1.735	-1.579	-2.379	1.317
6.5	40.0	-7.114	-5.764	-4.961	-4.292	-3.404	-2.760	-2.461	-2.196	-1.906	-1.781	-2.592	1.163
6.5	50.0	-7.246	-5.897	-5.091	-4.441	-3.559	-2.881	-2.582	-2.352	-2.102	-2.017	-2.825	1.012
6.5	60.0	-7.212	-5.903	-5.098	-4.418	-3.577	-2.937	-2.645	-2.414	-2.197	-2.163	-2.960	.968
6.5	70.0	-7.248	-5.914	-5.115	-4.440	-3.523	-2.971	-2.705	-2.486	-2.284	-2.301	-3.074	.975
6.5	80.0	-7.258	-5.946	-5.127	-4.429	-3.639	-3.024	-2.753	-2.551	-2.392	-2.436	-3.192	.907
6.5	90.0	-7.250	-5.965	-5.164	-4.504	-3.639	-3.037	-2.787	-2.615	-2.481	-2.584	-3.303	.871
6.5	100.0	-7.268	-5.946	-5.171	-4.509	-3.649	-3.102	-2.848	-2.696	-2.593	-2.705	-3.403	.818
6.5	110.0	-7.320	-6.006	-5.245	-4.578	-3.726	-3.178	-2.946	-2.801	-2.717	-2.909	-3.549	.740
6.5	120.0	-7.360	-6.064	-5.279	-4.594	-3.789	-3.261	-3.032	-2.912	-2.845	-3.072	-3.660	.695
6.5	130.0	-7.415	-6.102	-5.329	-4.687	-3.864	-3.348	-3.147	-3.000	-2.980	-3.218	-3.795	.612
6.5	140.0	-7.439	-6.150	-5.383	-4.728	-3.936	-3.413	-3.204	-3.095	-3.101	-3.381	-3.894	.549
6.5	150.0	-7.474	-6.202	-5.436	-4.825	-4.001	-3.487	-3.293	-3.201	-3.227	-3.557	-4.024	.461
6.5	200.0	-7.668	-6.368	-5.641	-5.027	-4.258	-3.830	-3.669	-3.650	-3.834	-4.209	-4.500	.196
5.5	1.0	-7.528	-5.972	-4.964	-4.086	-2.868	-1.765	-1.299	-.898	-.409	-.053	-.707	2.106
5.5	2.0	-7.578	-6.026	-5.022	-4.140	-2.919	-1.871	-1.335	-.925	-.424	-.121	-.769	2.029
5.5	3.0	-7.665	-6.107	-5.111	-4.212	-3.017	-1.921	-1.439	-1.022	-.545	-.192	-.861	1.942
5.5	4.0	-7.732	-6.173	-5.184	-4.304	-3.091	-1.983	-1.495	-1.063	-.625	-.302	-.971	1.860
5.5	5.0	-7.824	-6.272	-5.289	-4.397	-3.211	-2.097	-1.616	-1.193	-.734	-.403	-1.086	1.739
5.5	6.0	-7.896	-6.340	-5.350	-4.493	-3.264	-2.205	-1.719	-1.285	-.864	-.501	-1.215	1.631
5.5	7.0	-8.003	-6.430	-5.437	-4.561	-3.350	-2.312	-1.799	-1.403	-.952	-.647	-1.328	1.527
5.5	8.0	-8.102	-6.538	-5.571	-4.658	-3.490	-2.400	-1.922	-1.512	-1.067	-.750	-1.474	1.405
5.5	9.0	-8.154	-6.580	-5.628	-4.724	-3.582	-2.478	-2.008	-1.588	-1.163	-.849	-1.569	1.311
5.5	10.0	-8.256	-6.696	-5.718	-4.843	-3.656	-2.559	-2.085	-1.661	-1.241	-.929	-1.650	1.223
5.5	12.0	-8.413	-6.818	-5.830	-4.963	-3.778	-2.700	-2.242	-1.843	-1.413	-1.111	-1.832	1.090
5.5	15.0	-8.600	-7.017	-6.025	-5.152	-3.978	-2.961	-2.444	-2.062	-1.645	-1.345	-2.089	.863
5.5	20.0	-8.845	-7.272	-6.285	-5.428	-4.264	-3.192	-2.734	-2.355	-1.960	-1.671	-2.436	.581
5.5	25.0	-9.074	-7.506	-6.526	-5.667	-4.474	-3.427	-2.970	-2.588	-2.192	-1.960	-2.747	.326
5.5	30.0	-9.244	-7.666	-6.693	-5.863	-4.633	-3.659	-3.183	-2.809	-2.437	-2.205	-3.021	.120
5.5	35.0	-9.419	-7.846	-6.851	-5.976	-4.812	-3.793	-3.327	-2.980	-2.629	-2.467	-3.266	-.042
5.5	40.0	-9.547	-7.970	-6.995	-6.131	-4.967	-3.960	-3.493	-3.145	-2.802	-2.656	-3.469	-.212
5.5	50.0	-9.654	-8.081	-7.112	-6.262	-5.069	-4.134	-3.665	-3.333	-3.028	-2.919	-3.734	-.384
5.5	60.0	-9.706	-8.112	-7.139	-6.329	-5.112	-4.183	-3.722	-3.406	-3.123	-3.054	-3.894	-.471
5.5	70.0	-9.706	-8.128	-7.141	-6.332	-5.132	-4.209	-3.764	-3.464	-3.213	-3.214	-4.033	-.506
5.5	80.0	-9.713	-8.119	-7.147	-6.312	-5.159	-4.238	-3.803	-3.533	-3.333	-3.372	-4.168	-.552
5.5	90.0	-9.738	-8.145	-7.169	-6.346	-5.202	-4.289	-3.877	-3.601	-3.433	-3.500	-4.290	-.606

5.5	100.0	-9.755	-8.158	-7.180	-6.369	-5.230	-4.341	-3.904	-3.689	-3.532	-3.640	-4.392	-661
5.5	110.0	-9.822	-8.228	-7.251	-6.443	-5.329	-4.442	-4.039	-3.804	-3.680	-3.838	-4.556	-771
5.5	120.0	-9.897	-8.271	-7.300	-6.519	-5.393	-4.505	-4.122	-3.890	-3.816	-4.034	-4.698	-856
5.5	130.0	-9.929	-8.322	-7.339	-6.594	-5.450	-4.577	-4.204	-4.006	-3.963	-4.191	-4.834	-933
5.5	140.0	-9.963	-8.374	-7.406	-6.648	-5.535	-4.702	-4.324	-4.112	-4.104	-4.364	-4.967	-1.025
5.5	150.0	-10.022	-8.431	-7.468	-6.680	-5.599	-4.726	-4.405	-4.223	-4.203	-4.520	-5.090	-1.106
5.5	200.0	-10.216	-8.652	-7.680	-6.954	-5.884	-5.082	-4.807	-4.714	-4.825	-5.235	-5.628	-1.457

* M is moment magnitude; R is epicenter distance; PSA gives the nature-logarithm values of 5% damped Pseudo-Spectral Acceleration; PGA gives the nature-logarithm values of Peak Ground Acceleration; and PGV gives the nature-logarithm values of Peak Ground Velocity.