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Supporting Information for

Global variation of pulse-like ground motions characterized from 3D rotation seismic data

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Introduction

This file contains two supporting figures and two supporting tables for the manuscript “Global variation of pulse-like ground motions characterized from 3D rotation seismic data”. Supporting figures describe the genesis mechanism of velocity pulse, average response spectra of pulse records. Supporting table S1 provides detailed information about the seismic events and table S2 depicts different site types.

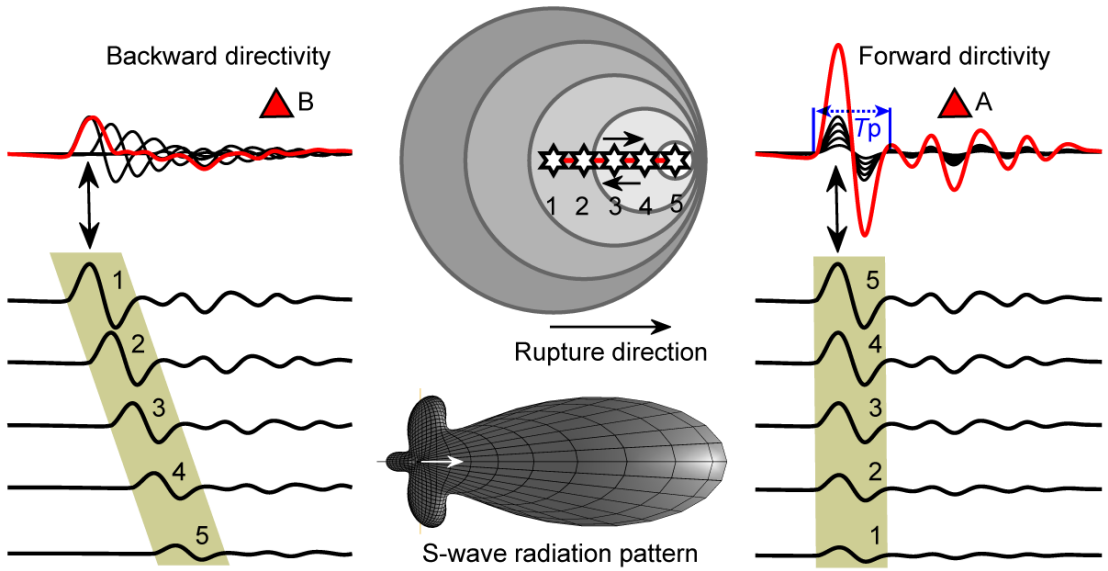

Figure S1. Schematic diagram of waveform superposition and S-wave radiation pattern from a unilateral rupture fault. The rupture direction of the fault propagates from sub-source 1 to 5. Stations A and B (red triangles) are located in the same and opposite directions of rupture propagation, respectively, and are equidistant from each fault end. The black curve represents the individual ground motion waveform generated from each sub-source (white star), whereas the red curve indicates the total waveform accumulated from all of the sub-sources.

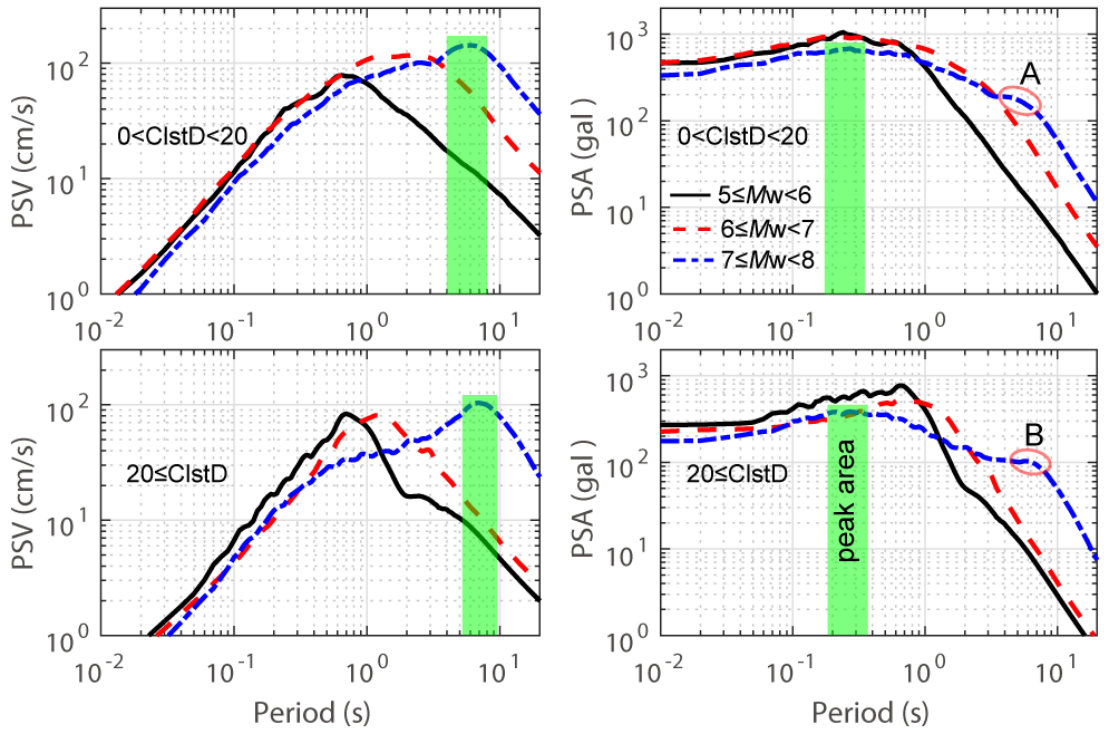

Figure S2. Average pseudo-spectral velocity (PSV) and pseudo-spectral acceleration (PSA) calculated from pulse records. The near- and far-fields are bounded by a distance of 20 km, of which the closest distance (ClstD) is from the recording station to the fault rupture plane. Solid black, dashed red, and dashed blue lines represent the average spectra of magnitudes 5–6, 6–7, and 7–8, respectively. The green shadow shows the effective peak region corresponding to the characteristic period of the maximum earthquake magnitude interval. Ellipses A and B are the second inflection points in the descending section of the average acceleration spectra.

Table S1.

Basic information of earthquake events with velocity pulses considered in this study

No.	Earthquake Name	Year	Magnitude (*M*w)	Depth (km)	Pulses	Fault Type
1	Northern Calif-03	1954	6.50	10.0	1	SS
2	San Fernando	1971	6.61	13.0	1	R
3	Tabas, Iran	1978	7.35	5.8	1	R
4	Montenegro, Yugo.	1979	7.10	7.0	2	R
5	Coyote Lake	1979	5.74	8.0	4	SS
6	Imperial Valley-06	1979	6.53	10.0	15	SS
7	Imperial Valley-07	1979	5.01	9.5	1	SS
8	Mammoth Lakes-06	1980	5.94	14.0	1	SS
9	Irpinia, Italy-01	1980	6.90	9.5	2	NM
10	Westmorland	1981	5.90	2.3	2	SS
11	Coalinga-02	1983	5.09	12.0	2	R
12	Coalinga-05	1983	5.77	7.4	1	R
13	Coalinga-07	1983	5.21	8.4	1	R
14	Morgan Hill	1984	6.19	8.5	2	SS
15	Taiwan SMART1(40)	1986	6.32	15.8	29	R
16	N. Palm Springs	1986	6.06	11.0	2	OB
17	Kalamata, Greece-02	1986	5.40	5.0	1	NM
18	San Salvador	1986	5.80	10.9	2	SS
19	Whittier Narrows-01	1987	5.99	14.6	7	OB
20	Loma Prieta	1989	6.93	17.5	11	OB
21	Erzican, Turkey	1992	6.69	9.0	1	SS
22	Joshua Tree, CA	1992	6.10	12.4	1	SS
23	Cape Mendocino	1992	7.01	9.5	4	R
24	Landers	1992	7.28	7.0	3	SS
25	Northridge-01	1994	6.69	17.5	15	R
26	Kobe, Japan	1995	6.90	17.9	4	SS
27	Kocaeli, Turkey	1999	7.51	16.0	4	SS
28	Chi-Chi, Taiwan	1999	7.62	8.0	46	OB
29	Chi-Chi, Taiwan-03	1999	6.20	7.8	6	R
30	Chi-Chi, Taiwan-04	1999	6.20	18.0	1	SS
31	Chi-Chi, Taiwan-06	1999	6.30	16.0	3	R
32	Duzce, Turkey	1999	7.14	14.0	3	SS
33	Yountville	2000	5.00	10.1	1	SS
34	Tottori, Japan	2000	6.61	13.0	1	SS
35	Denali, Alaska	2002	7.90	8.9	1	SS
36	Bam, Iran	2003	6.60	6.0	1	SS
37	Parkfield-02, CA	2004	6.00	8.1	12	SS
38	Niigata, Japan	2004	6.63	10.6	2	R
39	Chuetsu-oki	2007	6.80	9.0	9	R

40	Wenchuan, China	2008	7.90	10	2	R
41	Iwate	2008	6.90	6.5	2	R
42	L'Aquila, Italy	2009	6.30	9.3	3	NM
43	El Mayor-Cucapah	2010	7.20	5.5	3	SS
44	Darfield, New Zealand	2010	7.00	10.9	13	SS
45	Christchurch, New Zealand	2011	6.20	6	6	OB
46	Hualien, Taiwan	2018	6.40	6.3	12	SS

47 SS, strike-slip fault; NM, Normal fault; R, reverse fault; OB, oblique slip fault.

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51 **Table S2.**

52 Site classifications based on *Vs*30 and geotechnical conditions

Site Category	*Vs*30 (m/s)	Geotechnical Condition
A	>1500	Hard rock
B	1500-760	Firm to hard rock
C	760-360	Dense soil and soft rock
D	360-180	Stiff soil
E	<180	Soft soil

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