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Supporting Information for

On the relation of earthquake stress drop and ground motion variability

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Contents of this file

Figures S1 to S7



Figure S1: Total residual distribution with a) distance and b) moment magnitude for the nonparametric ground motion model determined for I_{JMA, equiv}. Data from the four regions of interest are highlighted in different colors (see legend). No significant trends can be seen either with distance or magnitude, indicating that the determined ground motion model provides an overall unbiased representation of the data.



Figure S2: Same as Figure S1, for the parametric ground motion model for I_{JMA, equiv.}



Figure S3: Same as Figure S1, for the non-parametric ground motion model for PGA.



Figure S4: Same as Figure S1, for the parametric ground motion model for PGA.



Figure S5: Relationship between PGA and a₀ (acceleration parameter used to calculate JMA equivalent intensity, see equation 2 in main text) for the different regions in the dataset. Note that for high PGA levels a₀ becomes larger than following a simple linear trend while at the lower PGA end, the opposite holds true. SW Honshu has a tendency to depict lower a₀ levels for a given PGA value, especially for moderate to large PGAs.



Figure S6: Results from the parametric mixed-effects regression procedure on the PGA data, same as Figure 8 in main text. a) BS residuals δB_{seq} (see also equation 5) for the individual earthquake sequences extracted from the dataset. b) Between-event residuals δB_e color-coded and ordered with increasing stress drop in each of the four analyzed regions. c) δB_e versus $\Delta \tau$ color-coded by region, see also Figure 7 in main text for the corresponding non-parametric case.



Figure S7: Distribution of site terms S_i as obtained from the non-parametric regression analysis (equation 3 in main text), for $I_{JMA, equiv.}$ and PGA. Top: S_i values for surface and borehole stations. Bottom: S_i values for borehole stations only. Note that for $I_{JMA, equiv.}$ and the borehole data only, these values tend to be slightly positive in Kyushu while slightly negative in SW Honshu, relative to the reference condition of zero average over all of Japan.