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Low-parametric modeling of the 2015, M_W 8.3 Illapel, Chile earthquake

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Key Words

Illapel earthquake, Chile; low-frequency modeling; multiple-point source models; empirical Green's functions; fault segmentation; rupture speed.

Abstract

The M_W 8.3 (GCMT) Illapel megathrust earthquake is investigated. The objective is to find out which features of the previously published rupture scenarios can be resolved by using a regional strong-motion network (epicentral distances 130-260 km) and source models with a few parameters only. Low-frequency waveforms (<0.05 Hz) at nine stations (Centro Sismológico Nacional, Chile) are subjected to modeling. Various representations of the source are used: (i) multiple-point source models based either on iterative deconvolution or simultaneous inversion of source pairs, (ii) models of circular and elliptical uniform-slip patches, employing synthetic and empirical Green's functions, respectively. This variety of methods provides consistent results. The earthquake appears to be a segmented rupture progressing from an early (deep) moment release to a later (shallow) one, towards the northwest. The source models of slip-uniform patches synchronously suggest a low rupture speed of 1-2 km/s. Despite the different data sets and methods used in this study, the estimate of rupture speed is consistent with independent publications. As for ambiguity in literature regarding the depth and timing of the rupture, our paper clearly prefers the models including a ~20-30 s delay of the shallow moment release compared to the initial deep one. The strong-motion data set and low-parametric models proved to be competitive with more sophisticated approaches like multi-parameter slip models using a variety of regional geophysical observables. These results, together with the results from other studies for smaller events, show that strong-motion networks can be useful for studying rupture processes in a wide range of magnitudes, thus promoting the improvement of regional strong-motion networks in poorly instrumented regions.