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Imaging finite-fault earthquake source by iterative deconvolution and stacking (IDS) of near-field complete seismograms

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By combining the complementary advantages of conventional inversion and back-projection methods, we have developed an iterative deconvolution and stacking (IDS) approach for imaging earthquake rupture processes with near-field complete waveform data. This new approach does not need any manual adjustment of the physical (empirical) constraints, such as restricting the rupture time and duration, smoothing the spatiotemporal slip distribution, etc., and therefore has the ability to image complex multiple ruptures automatically. The advantages of the IDS method over traditional linear or non-linear optimization algorithms are demonstrated by the case studies of the 2008 Wenchuan (China), 2011 Tohoku (Japan) and 2014 Pisagua-Iquique (Chile) earthquakes. For such large earthquakes, the IDS method is considerably more stable and efficient than previous inversion methods. Additionally, the robustness of this method is demonstrated by comprehensive synthetic tests, indicating its potential contribution to tsunami early warning and earthquake rapid response systems. It is also shown that the IDS method can be used for teleseismic waveform inversions. For the 2011 Tohoku earthquakes, for example, the IDS method can provide, without tuning any physical or empirical constraints, teleseismic rupture models consistent with those derived from the near-field GPS and strong-motion data.