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The 2014 Pisagua-Iquique earthquakes: high-resolution kinematic source models by joint inversion of the strong-motion and GPS data

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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. A high-resolution (ca. [U+F0A3] 10 km) source imaging is achieved for the 2014 Pisagua-Iquique earthquakes by applying the IDS approach to the regional strong-motion and GPS data jointly. It reveals more physical insights into the rupture process. For such large earthquakes, there exists generally a clear rupture front propagating with a finite velocity, but no clear healing front following the rupture front, implying that single rupturing is special, multiple rupturing is general. Each of the two earthquakes consists of several major sub-events and numerous coseismic early aftershocks, which can trigger each other statically and/or dynamically. The peak fault slip is generally not formed by a single rise-time, but through a cumulative process that can last as long as the whole earthquake duration. The rupture plane of large earthquakes might not be a simple smooth surface, but a rough surface or even a rupture zone with certain thickness (a few km?) consistent with the aftershock clustering around the fault.