

**Coseismic radiation and stress drop during the 2015 Mw 8.3 Illapel, Chile megathrust earthquake**

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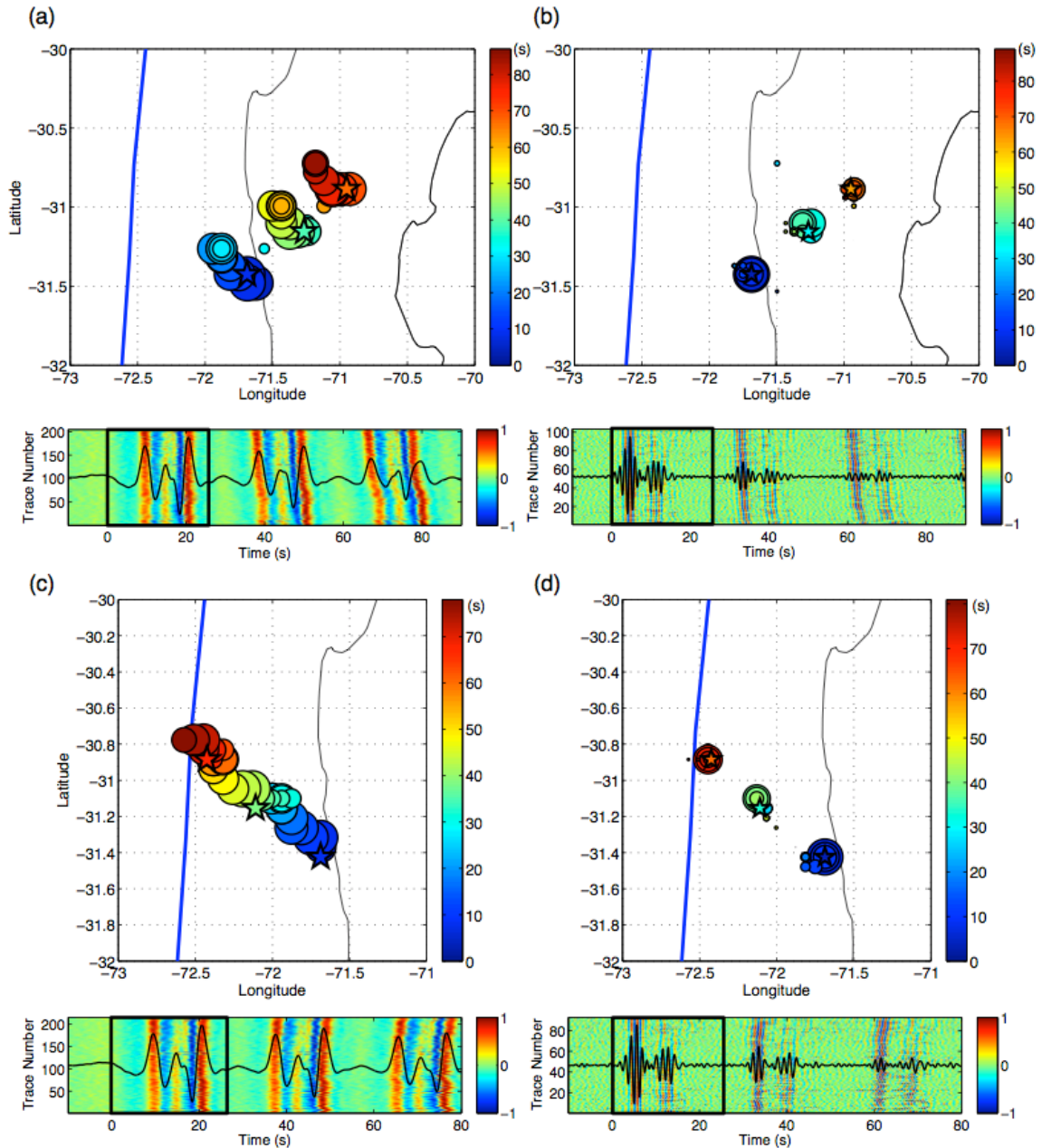
Text S1  
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**Introduction**

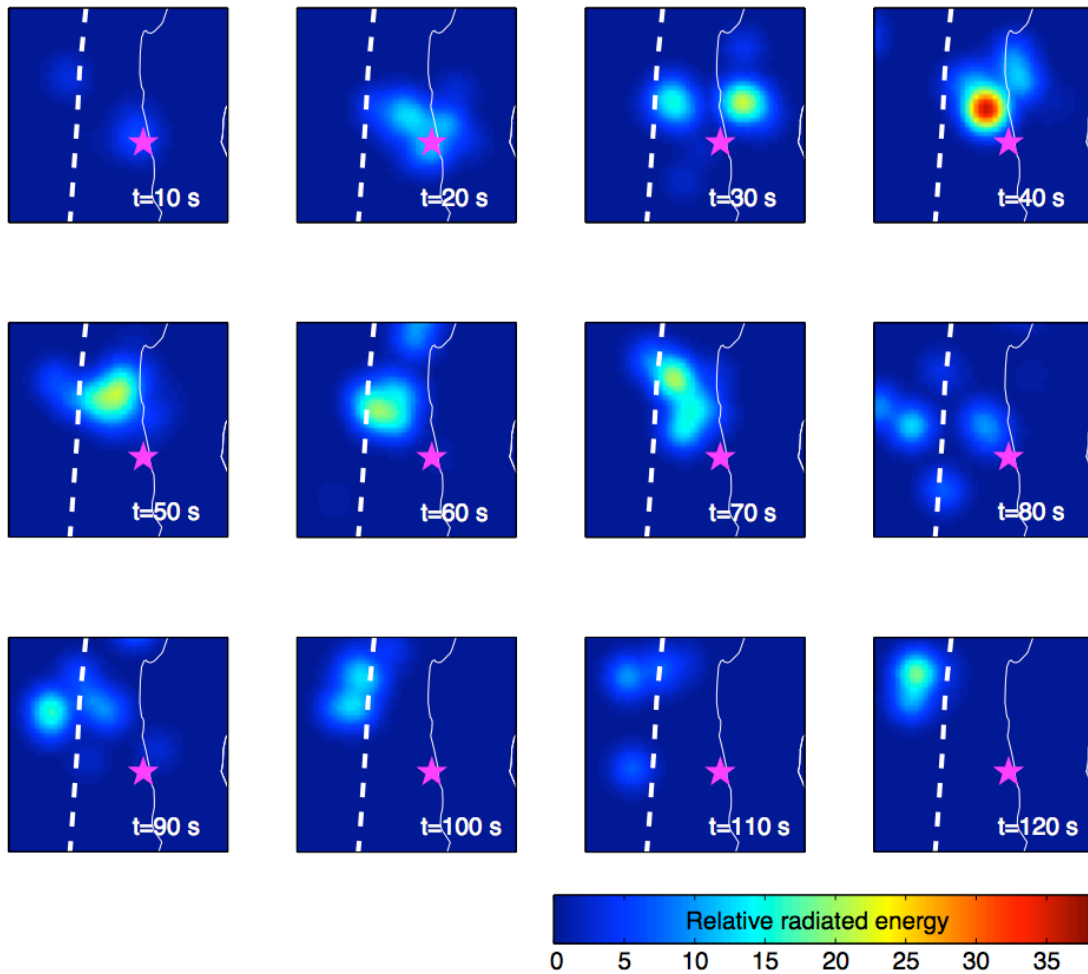
In this supporting material, we show the results of the resolution tests for our method to prove its robustness and in the meanwhile, based on the results, we have checked the influences of the inevitable depth phases (such as pP and sP) as well as the number of stations on our results (Fig. S1). We also show the snapshots of the coseismic radiation sources propagation from our results in both LF (0.05-0.5Hz, Fig.S2) and HF (0.5-1Hz, Fig.S3) bands.

### **Text S1.**

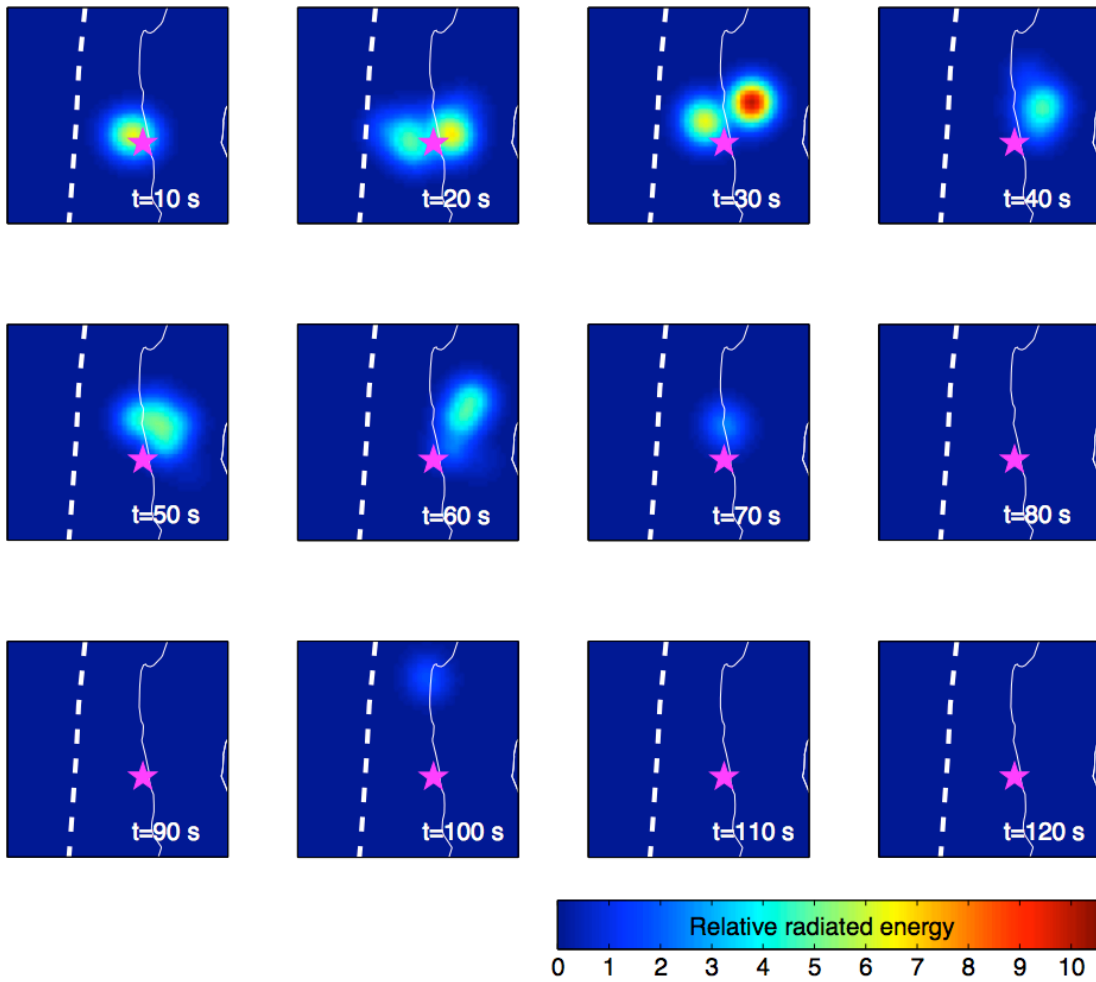
Here we give resolution tests of the compressive sensing (CS) method. The synthetic waveforms from multiple point sources (stars in Fig. S1) are directly from the time-shift and stack of the first 26s of P waves and its coda recorded at each station from an Mw 6.5 aftershock near the epicenter of the mainshock. The waveforms of this Mw 6.5 event contain the pP phase that is about 8s later than and almost overlapped with the first P arrival, and the obvious sP phase, which is about 12s later than the first P arrival. The recovery of these synthetic sources is shown in Fig.S1. The results of the synthetic tests indicate that the depth phase will produce some artifacts towards the direction of stations, especially in LF (see Fig.S1a). Fortunately, for this event, our results and other results (e.g. USGS and EOS preliminary results; Heidarzadeh et al., 2015; Tilmann et al., 2015; Ye et al., 2015) all indicate northwestward rupture propagation. In this direction, the influence of depth phases is limited (as shown in Fig.S1c) and does not conflict with the overall rupture propagation. In the meanwhile, in these synthetic tests, we only randomly select 50% of the stations to do the inversion in order to prove that different number of stations will not have big effects on our results.



**Figure S1.** Results of resolution tests. The recovery of these synthetic sources is shown in (a) downdip propagating sources in LF (0.05-0.5Hz); (b) downdip propagating sources in HF (0.5-1Hz); (c) updip propagating sources in LF (0.05-0.5Hz); (d) updip propagating sources in HF (0.5-1Hz). The synthetic waveforms are composed by the waveforms of an Mw 6.5 aftershock and shown at the bottom of each plot for each case. Stars indicate the positions of our synthetic sources and circles (color for source initial time) are the recovered sources using our CS inversion method. Black boxes in the lower panels indicate the original 26s waveforms and the stacked waveform (black trace) of all stations of this event.



**Figure S2.** Time snapshots of the LF (0.05-0.5Hz) seismic radiation power from CS inversion. Purple stars indicate the epicenter position and white dashed lines show the trench location. The map region shown is the same as those in Fig.3 and Fig.4. The central time of each sliding window is shown as the white text in each plot.



**Figure S3.** Time snapshots of the HF (0.5-1Hz) seismic radiation power from CS inversion. Other symbols are the same as those in Fig. S2.

## Reference

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- Ye, L., T. Lay, H. Kanamori, and K. D. Koper (2015), Rapidly Estimated Seismic Source Parameters for the 16 September 2015 Illapel, Chile M w 8.3 Earthquake, *Pure Appl. Geophys.*, 1–12, doi:10.1007/s00024-015-1202-y.