Title: Real-data Demonstration of Distributed Acoustic Sensing for Offshore Earthquake Early Warning

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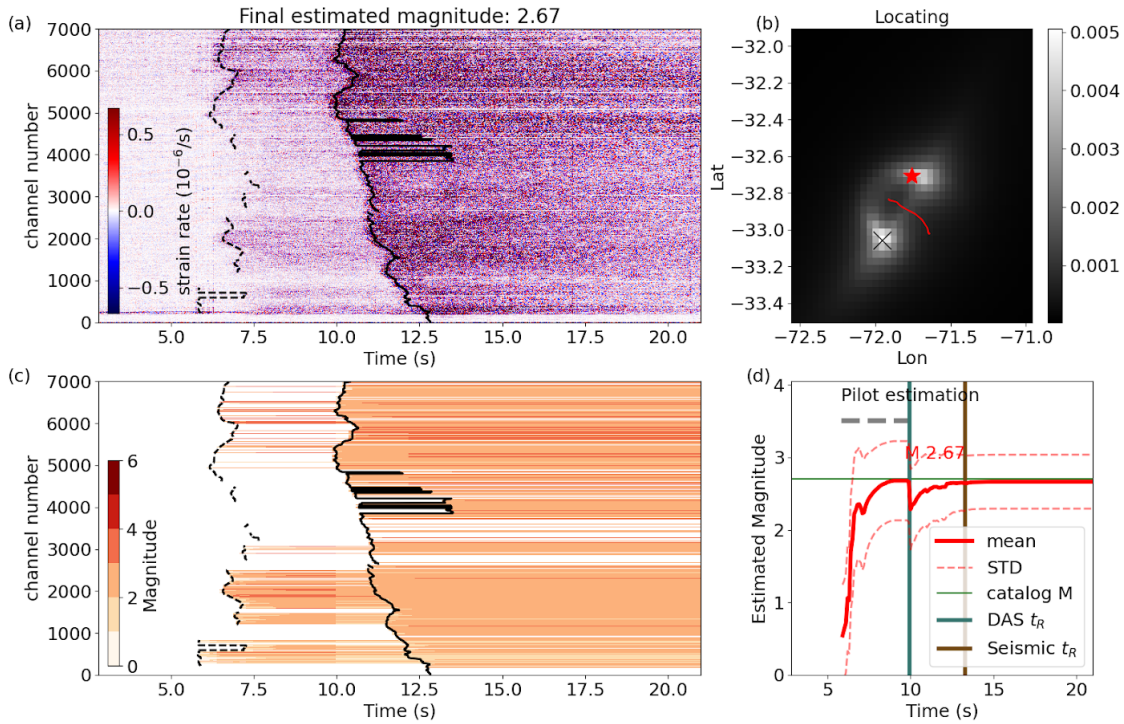
Abstract

Earthquake Early Warning (EEW) is critical to mitigating seismic hazards. However, submarine earthquakes are still challenging due to the sparse offshore seismic networks. Distributed Acoustic Sensing (DAS) can complement the current EEW systems by converting the submarine fiber-optical cables into dense seismic arrays. In this study, we demonstrate DAS for offshore EEW using earthquakes recorded by a DAS array offshore Chile along the Curie submarine cable. We explore the methodology to use DAS arrays for EEW. We first constrain earthquake locations using P and S waves recorded over the Curie DAS array. Then, with site effects along the cable calibrated using an independent earthquake, we estimate earthquake magnitudes directly from strain rate amplitudes by applying a well-calibrated scaling relation from onshore DAS arrays. The results show about 3 seconds earlier in alert time with a single 50-km DAS array than using onshore seismic stations. We further simulate to demonstrate that, with one DAS array placed every 50 km along the coast and each extending 100 km towards the trench, it is possible to improve the alert time uniformly along a subduction zone by an average of 5 seconds.



DAS-EEW results of the M2.7 Valparaíso earthquake.