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A Method to Improve Relative Earthquake Locations Using Surface Waves

Current earthquake-location capabilities provide no better than 25-km precision in remote areas, which is insufficient for many investigations. Surface waves, with their slow horizontal propagation speeds and high signal strength even at teleseismic distances, contain information on earthquake location that can improve epicenter determinations. Earlier work by other authors has demonstrated the possibility of precise relative location by cross-correlation of Rayleigh waves for pairs of earthquakes with the same focal mechanism and depth, and Cleveland and Ammon (2013) have recently demonstrated success with this approach for multiple events with similar mechanisms and a double-difference relocation method. For earthquakes with arbitrary focal mechanisms, we extend earlier approaches to improve relative locations for events beneath oceans and in subduction zones (where most seismic activity occurs). We correct inter-event cross-correlation functions of Love and Rayleigh surface-wave signals for differences in focal mechanisms and depths before calculating cross-correlation delay times and relative locations. Experiments on full synthetic seismograms indicate that the algorithm results in improved locations in the presence of realistic uncertainties in earthquake focal depths and mechanisms. We present results from the synthetic experiments and applications to real data, using earthquakes from the Global CMT catalog representing different tectonic environments.

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