The effectiveness of Green's Function based Time Reverse Imaging method for tsunami source estimate

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We developed a Green's Function based Time Reverse Imaging (GFTRI) method in order to recover the initial sea surface displacement associated with tsunami generated by undersea earthquake, submarine landslide etc. This method has the same source representation as the least square (LSQ) source inversion method. In GFTRI method, the source region is divided into a number of source patches and Green’s functions (GF) are computed using a unit point source located over each source patch. Instead of using LSQ method, this method uses time reverse imaging method to estimate tsunami source by convolving GFs with time-reversed observed waveforms. This method was implemented in the 2011 Tohoku-Oki earthquake tsunami. In this work, we implemented the method to the 2009 Samoa tsunami whose source mechanism is believed to be complex. For this event, only few observations are available and many of them are located quite far way from the source and contain reflected, refracted, or even scattered waves. So, it is an ideal event to examine whether the method is capable of reconstructing a source model associated with earthquake source having double-couple feature using only the first wave (FW) or the first wave with later arrivals (FL). We carried out several experiments with synthetic waveforms and results indicate that the method is able to extract complex features of the earthquake. We, then, applied this method with actual tsunami waveforms of the Samoa 2009 tsunami (both FW and FL) and our results suggest that this tsunami occurs due to both normal and thrust faulting. Our finding is very consistent with previous studies of seismic waveforms for this earthquake that have suggested the event is a doublet, consisting of both an outer rise normal fault and megathrust rupture.

Keywords: Tsunami , time reverse imaging, source inversion

