Source Properties of the January 2010 M7 Haiti Earthquake Estimated by Back Projection of Waves Recorded by the National Seismic Network of Venezuela and the USArray

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Abstract
Back projection of teleseismic waves based on array processing has become a popular technique for earthquake source inversion. By tracking the time-delays for different frequency bands, the array processing is typically performed as the back-projection of the source into the observation region. The direction of arrival is then calculated from the velocity model. The seismograms are then shifted back and stacked to obtain the spectrum of energy radiation of all sources. This study makes an effort towards imaging Haiti earthquake using back projection of waves recorded by the Venezuela network and the USArray.

Multiple signal classification (MUSIC)
As an effort to improve the resolution of back projection, the MUSIC method was developed to estimate the source location based on the data covariance matrix using an appropriate projection matrix. The MUSIC method assumes that the signals are composed of multiple wave arrivals from different directions plus Gaussian noise added onto the wave field, the eigenvectors corresponding to the largest eigenvalues span the signal subspace, while the rest of the small eigenvalues span the noise space. A steering vector, which is a vector of complex phase shifts as a function of frequency, sensor locations and signal subspace, while the rest of the small eigenvectors span the noise space. A steering vector, which is a set of complex phase shifts as a function of frequency, sensor locations and signal subspace. The MUSIC method is then obtained by the iterative Kikuchi-Kanamori. We computed synthetic Green's function using the 3D forward modeling code VHELLO and the Kikuchi-Kanamori decomposition technique (KLT) to test a 4D T-W decomposition and a 4D T-W decomposition and a 4D T-W decomposition. We apply both methods on the data from the source-time function and conclude that the MUSIC method provides a more robust determination of the source location uncertainty and a more robust determination of the source location uncertainty. We find that the MUSIC method provides a more robust determination of the source location uncertainty and a more robust determination of the source location uncertainty.

Synthetic test
To understand the performance and potential bias of the back-projection method using the Venezuela network, we use the two algorithms by synthesis. We compute the full wave synthetics using a Frequency-Response Function (FRF) method [10]. We test scenarios with a fixed source, a moving source and a moving source with rotation. The synthetic seismograms were broadly consistent with the initial P arrival. The two proposed back-projection techniques are then applied.

Conclusions
Back projection of regional and teleseismic seismic data from the Venezuela network and the USArray make the seismic data valuable in the source process of the Haiti earthquake with speculate decay occurring in the time domain. Application of a multistep back-projection (MBP) yields a sharper source image than classic beamforming.

1.1 Back projection of regional seismic data from the Venezuela network with back projection having a higher degree of accuracy and sensitivity than classic beamforming.
2.3 Back projection of regional seismic data from the Venezuela network with back projection having a higher degree of accuracy and sensitivity than classic beamforming.