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Wavelet domain inversion for examination of the frequency-dependent characteristics of the seismic wave radiation

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Frequency-dependent characteristics of the seismic wave radiation from earthquake sources are important subject for advancing the source physics and the strong-motion prediction. The 2011 Tohoku-Oki earthquake has exhibited particularly distinctive characteristics. The large slip is estimated in the shallow part of the fault from the low-frequency waveforms or geodetic data, whereas the source models derived from the analysis of the higher-frequency seismic data, such as the empirical Green's function modeling or backprojection method, suggest that the high-frequency waves were intensely radiated from the deeper portion. Our previous study (Suzuki et al., 2011) examined the contribution of the significant slip events to the waveform synthesis from the low-frequency waveform inversion results. We found that the sources of the very-low-frequency waves (<0.02 Hz) and higher-frequency waves seem different in the location even in the frequency band used in the waveform inversion. The examination on the frequency dependence in this previous study is somewhat indirect. We have therefore developed the source inversion method that utilizes the wavelet coefficients as the target to fit. This new method is based on the multi-time-window scheme and is linear inversion. The moment rate is directly related to the waveform in each octave band. We have first applied the developed method to 0.01-0.125 Hz strong-motion data of the largest aftershock of the Tohoku-Oki event that occurred in the off Ibaraki prefecture. The preliminary analysis does not suggest the clear frequency dependence for this Mw7.9 event in the analyzed frequency band. As future work, we will extend the analyzed frequency range and also apply to the Tohoku-Oki mainshock.

References:
Suzuki, W., S. Aoi, H. Sekiguchi, and T. Kunugi (2011): *Geophys. Res. Lett.*, **38**, L00G16.