Isolating retrograde and prograde Rayleigh wave modes using a polarity mute

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Estimates of shear wave velocity with depth from Rayleigh wave dispersion data is limited by the accuracy of fundamental and/or higher mode signal identification. In many scenarios, the fundamental mode propagates in retrograde motion while higher modes propagate in prograde motion. This difference in particle motion (or polarity) can be utilized by joint analysis of vertical and horizontal inline recordings. We present a novel method that isolates modes by separating prograde and retrograde motions; we call this a polarity mute. Applying this polarity mute prior to traditional MASW analysis improves phase velocity estimation for fundamental and higher mode dispersion. This approach, in turn, should lead to improvement of shear wave velocity estimates with depth. With two simple models and a field example, we highlight the complexity of Rayleigh wave particle motions and demonstrate improved MASW dispersion images using the polarity mute. Our results show that we can separate prograde and retrograde signals to independently process fundamental and higher mode signals, in turn allowing us to identify lower frequency dispersion when compared to single component data. These examples demonstrate that the polarity mute approach can improve estimates of shear wave velocities with depth.

Phase velocity vs. frequency coherence images for the field data with yellow denoting high coherence and dark blue denoting low coherence. a) raw vertical component data; b) raw horizontal component; c) vertical component after prograde polarity mute; d) horizontal component after prograde polarity mute; e) vertical component after retrograde polarity mute; f) horizontal component after retrograde polarity mute. Color scale indicates the coherence relative to maximum coherence in each plot.