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Effects of 3D Earth structure on W-phase CMT parameters

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The source inversion of the W-phase has demonstrated a great potential to provide fast and reliable estimates of the centroid moment tensor (CMT) for moderate to large earthquakes. It has since been implemented in different operational environments (NEIC-USGS, PTWC, etc.) with the aim of providing rapid CMT solutions. These solutions are in particular useful for tsunami warning purposes. Computationally, W-phase waveforms are usually synthetized by summation of normal modes at long period (100 – 1000 s) for a spherical Earth model (e.g., PREM). Although the energy of these modes mainly stays in the mantle where lateral structural variations are relatively small, the impact of 3D heterogeneities on W-phase solutions have not yet been quantified.

In this study, we investigate possible bias in W-phase source parameters due to unmodeled lateral structural heterogeneities. We generate a simulated dataset consisting of synthetic seismograms of large past earthquakes that accounts for the Earth's 3D structure. The W-phase algorithm is then used to invert the synthetic dataset for earthquake CMT parameters with and without added noise. Results show that the impact of 3D heterogeneities is generally larger for surface-waves than for W-phase waveforms. However, some discrepancies are noted between inverted W-phase parameters and target values. Particular attention is paid to the possible bias induced by the unmodeled 3D structure into the location of the W-phase centroid. Preliminary results indicate that the parameter that is most susceptible to 3D Earth structure seems to be the centroid depth.