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Evaluation of seismic sensor orientations in the full moment tensor inversion results

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Three-component seismograms recorded by seismic sensors are momentous data to study the source mechanism of earthquakes. Correct orientation of sensors relative to the true north is important for the waveform inversion techniques. Yet, the non-precise orientation of horizontal components of seismic sensors has been reported in many seismic networks worldwide. In this study, we evaluated the effect of sensor misorientations (deviations from the true north) on time-domain moment tensor inversion, relying on the recent sensor orientation studies on broadband seismic networks in Iran and Turkey. We selected several well-recorded countrywide local and regional moderate magnitude earthquakes, which are associated with the tectonic events, in the time period of 2012-2019. We calculated the moment tensor inversion of those events before and after applying the orientation correction using a Bayesian bootstrap-based probabilistic method. This leads to reaching the uncertainties and trade-offs of parameters and helps to stabilize the inversion. Our analysis shows that in the presence of misoriented sensors, an approximate solution is achievable. However, this includes the remarkable uncertainties in inverted parameters and makes the reliable determination of the moment tensor's elements challenging. We also found an additional significant non-double couple component while using the misoriented radial and transverse components. Results show that the misfit and uncertainties decrease significantly when sensor orientation correction applied. We suggest that the evaluation of metadata should be part of data processing in seismic networks and data centers, to report more reliable moment tensor solutions.