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Deriving Earthquake Rupture Timing from GPS observations

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We investigate the suitability of a quasi-static deformation evolution and propagation assumption for deriving rupture timing properties from coseismic GPS time series. To this purpose we convolve linear ramp source time functions with the final static value of deformation at the receiver assuming a propagation velocity corresponding to P-wave travel times. In order to validate and calibrate the inversion procedure, we generate synthetic scenarios with different epicenter and rupture speed. We then apply the inversion to coseismic GPS time series from the Sumatra 2004 earthquake to derive onset times at the subfaults. The inverted epicentral location and propagation direction qualitatively agree with seismic methods, but the obtained rupture velocity is too high. This is due to the large distance of several hundred kilometers from the earthquake to the receivers, where the quasi-static deformation assumption becomes invalid and signal to noise ratio is poor. However, we show that if near-field stations are available, which will be the case for many places in the near future, the suggested approach is a valuable complement to traditional seismic methods which is fast and robust.