Enhancement in EarthScope capabilities through seismogeodetic upgrades to PBO stations

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The seismogeodetic real-time combination of high-rate GPS observables and seismic acceleration captures the broadband on-scale recording of earthquake ground motions. This combination dataset will improve rapid kinematic fault slip models for the earthquake source for future earthquakes, but large-scale accelerometer deployment at the many available permanent GPS stations is limited by the cost of traditional observatory-grade accelerometers. Instead, we improved feasibility with the recent installation of SIO Geodetic Modules and low-cost MEMS accelerometers at 15 (PBO and SCIGN/SOPAC) GPS stations in southern California near the San Andreas, San Jacinto, and Elsinore faults, as well as at 10 PBO GPS stations in the San Francisco Bay Area spanning the Hayward and Roger's Creek faults. Assessment of the geodetic and seismic instrument combinations was conducted during testing of an inertial force-limiting anchorage design system for a four-story structure on the NEES @ UCSD Large High Performance Outdoor Shake Table (LHPOST). We present the optimization of the seismogeodetic combination comparing the use of an observatory-grade EpiSensor accelerometer to the low-cost MEMS alternative in combination with collocated geodetic receivers. Our comparison (Fig. 1) provides information on the range of earthquake magnitudes and distances for which the performance of the seismogeodetic combination using MEMS accelerometers is sufficiently close to the observatory-grade instruments to be useful in earthquake early warning and rapid earthquake response through magnitude scaling, CMT solutions, and finite-fault source models. We demonstrate the expected impact on these rapid products from the recent expansion of the seismogeodetic network in southern and northern California, using data from the 2010 Mw 7.2 El Mayor-Cucapah and 2014 Mw 6.0 South Napa earthquakes, respectively. Results provide confidence in the use of the MEMS accelerometer for large-scale deployment to supplement the limited number of observatory-grade accelerometers collocated with GPS instruments. This will improve rapid response to future earthquakes, as well as after-the-fact source modeling and tsunami forecasting and thus, provide a significant enhancement of EarthScope capabilities.

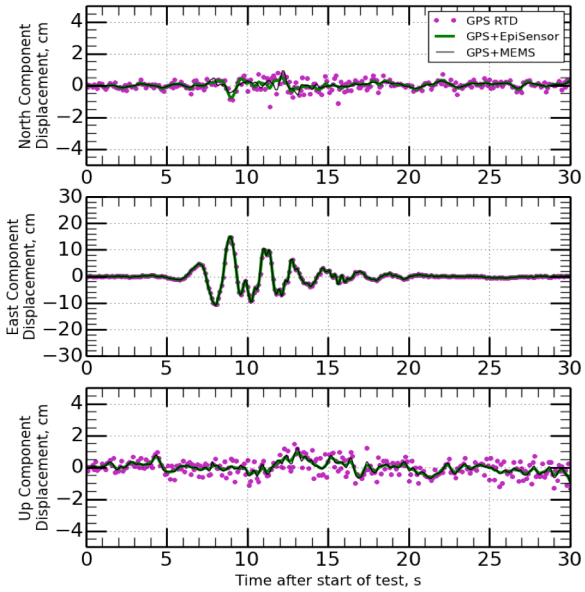


**Fig 1:** GPS observations & seismogeodetic solutions for collocated instruments on the foundation of a structure on the NEES LHPOST. Seismogeodetic solutions computed using parameters that account for high-frequency noise of the MEMS agree with those computed using an observatory-grade EpiSensor with an rms of ~0.9mm