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Application of GPS Data to Seismic Hazard Assessment in California and Elsewhere

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Space geodetic measurements in seismically active regions are becoming sufficiently mature that results can now be applied in probabilistic seismic hazard assessments (PSHA). An effort supported by U. S. Geological Survey (USGS) and the Southern California Earthquake Center (SCEC) and others is now underway to begin scientific consideration of how to incorporate space geodetic constraints on strain rates and fault slip rates into the next generation Uniform California Earthquake Rupture Forecast ("UCERF3") that is due to be completed in mid-2012. Here I provide a progress report on these activities, immediate and long-term research objectives, and implications for seismic hazard assessment elsewhere.

A number of goals potentially achievable within a year were identified including (1) slip rate and fault locking depth estimates—with uncertainties or ranges—for all major and some minor faults of the extended San Andreas system; (2) strain rate estimates or bounds on rates for selected regions lying off the major faults of the San Andreas system; and (3) corrections or bounds on perturbing effects of post-seismic deformation and elastic modulus heterogeneities on the observed GPS velocity field (needed as input to models for estimating fault slip and strain rates in 1. and 2. above).

Longer-term research priorities for improving fundamental understanding and better contributing to PSHA objectives of the USGS, SCEC and the international earthquake community were also identified. These include: (1) new observations and modeling of earthquake cycle deformation, focusing especially on better constraining the duration and spatial distribution of post-seismic transient deformation; (2) more refined block models that consider uncertainties in fault slip and intra-block strain rates due to variations in block geometry, long-term post-seismic transients, and lower crust/upper mantle rheological heterogeneities; and (3) improved strain rate mapping methodologies and space geodetic measurements that better capture the spatial heterogeneity of the surface strain rate field. These goals are being encouraged and facilitated through ongoing projects within USGS and SCEC, as well as in other earthquake science groups within the US and worldwide.