Characterizing Transient Strain Rate Departures From A Long-Term Strain Rate Field

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Continuous Global Positioning System (GPS) time series from the Southern California Integrated GPS Network (SCIGN) and the highly active margin along the western United States enables for high resolution, four-dimensional solutions of model velocities and strain rate field for southern California. SCIGN served as a nucleus for the upcoming EarthScope Plate Boundary Observatory (PBO) and the high sampling rate of the geodetic monuments is ideal for recognizing strain rate transients. While SCIGN does provide temporally dense displacement time series, until the PBO is fully operational, it is spatially sparse in some regions. We use PA-NA motion as a velocity boundary condition in all solutions and using bi-cubic splines as basis functions. We interpolate GPS velocity fields for spatially continuous estimates of the velocity gradient tensor field for two-week data epochs, thereby deriving a time dependent evolution of the strain rate field [Holt et al., 2000]. Each epoch solution includes a model strain rate estimated from Quaternary fault data [Shen-Tu et al., 1999] and geodetic data, all of which are later compiled as movies to evaluate the time dependent evolution of interseismic strain rates. This technique was applied to data spanning late 1999 through 2004 allowing us to recognize a first order strain rate transient following the October 1999 Hector Mine earthquake. Of particular interest are the strain rate corridor between Hector Mine and the San Andreas fault, a diminished strain rate along the Anza section of the San Jacinto fault, and the subsequent redistribution of strain rates along the San Jacinto fault [Fialko, 2006].

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References

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Figure 1. Model strain rate field (magnitude of strike slip component only) immediately following the October 1999 Hector Mine earthquake, velocity vectors are differences between epoch and long term strain rates. Note the asymmetric strain rate distribution between the San Andreas fault and the San Jacinto fault Anza section (top left). Redistribution along both strands after 1.5 years (top right), 3 years after earthquake (bottom left), and the final epoch solution (bottom right).