SLIP DEFICIT RATE INVERSIONS IN THE WESTERN U.S. INCORPORATING VISCOELASTIC EARTHQUAKE CYCLE EFFECTS

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This project addresses three fundamental challenges in working with strain rates: The non-uniqueness of strain rate estimates and the lack of clarity regarding their uncertainties, the underdeveloped methods for directly inferring slip deficit rates on faults from strain rates, and the quantification of off-fault deformation in areas of distributed deformation. To tackle these challenges, I employ a systematic approach to compute strain rate maps and their uncertainties across the western U.S., using various methods to derive strain rates from GNSS velocities. Additionally, I invert surface strain rates for slip deficit rates on faults included in the 2023 U.S. National Seismic Hazard Model (U.S. NSHM), leveraging a viscoelastic earthquake cycle model that incorporates time-dependent mantle flow due to the periodic locking and unlocking of faults. The inversion is performed using least squares coupled with a Monte Carlo procedure to construct the posterior distribution considering truncated Gaussian priors on slip deficit rates based on the preferred slip rate values in the U.S. NSHM.

Our preliminary results suggest that elastic and viscoelastic models explain 60-70 percent of the observed strain rates. However, there remains 30-40 percent of the strain rates that cannot be accounted for by coupling on faults in the 2023 NSHM fault model, highlighting areas for future investigation, particularly determining the nature and origin of off-fault deformation. Also, my analysis has identified the northern San Andreas, along with the Carrizo and Mojave segments of the San Andreas Fault, as regions with the highest slip deficit rates, where depth-averaged rates exceed 15 mm/year.