Interseismic strain accumulation in and water resources available to metropolitan Los Angeles

Donald F. Argus

GPS observations of interseismic strain accumulation and continental deformation in California are analyzed and augmented with trilateraion and InSAR data. The Mojave segment of the San Andreas Fault (SAF) is estimated to be slipping at 22 ±2 mm/yr beneath a locking depth of 18 ±3 km (95% conf. limits). This estimated SAF slip rate is significantly slower than the 35 mm/yr slip rate inferred from geology and expected from Pacific–Sierra Nevada plate motion. Fault-normal shortening at the Big (restraining) Bend in the SAF has over the past 2 Myr built the San Gabriel Mountains but the shortening has now shifted south to northern metropolitan Los Angeles. An elastic model of interseismic strain accumulation indicates that the Puente Hills Thrust (PHT) fault, a major blind thrust fault beneath metropolitan Los Angeles, is slipping at 8 mm/yr beneath a locking depth of 12 km. This estimated PHT slip rate is faster than inferred from paleoseismology (for the upper Elysian Park and PHT) and suggests that a M 6.5 to 7 earthquake to be more likely than previously thought.

GPS is accurately recording vertical motion of Earth's surface in elastic response to seasonal changes in surface water storage in California. California's mountains subside up to 12 mm in the fall and winter due to the load of snow and rain, then rise an identical amount in the spring and summer when the snow melts, the rain runs off, and soil moisture evaporates. GPS resolves the distribution of change in total water across California's physiographic provinces at a resolution of 50 km, compared to 200 km resolution from GRACE. Seasonal water oscillations are large in the Sierra Nevada, Klamath, and Cascade Mountains and decrease sharply east into the Great Basin and west toward the Pacific coast. GPS provides an independent inference of change in total surface water, indicating water storage to be 50 per cent larger than in the NLDAS–Noah hydrology model, likely due to larger changes in snow and reservoir water than in the model.