Comparison of geodetic and geologic vertical motion rates in the Southern California

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Abstract

Horizontal geologic and geodetic slip rate discrepancies are well documented for active faults in Southern California, however this discrepancy is significantly larger in the vertical direction. Therefore, rheological models used to constrain fault slip rates generally exclude vertical geodetic motions. Here, we compare geologic vertical rates from the Southern California Earthquake Center Vertical Motion Database and vertical GPS velocities from the EarthScope Plate Boundary Observatory. These two data are not necessarily co-located in space and geologic data are observed using four different markers - thermo-chronologic (TH), river terraces (RT), stratigraphic horizons (SH) and marine terraces (MT). Therefore, we extract subsets of the geologic data based on observation proximity with GPS locations, data measurement errors, as well as observation marker types and compare these subset geologic data with the geodetic data. For all subsets, geologic and geodetic data are poorly correlated, with correlation coefficient R being less than 0.3. The geologic data from SH primarily indicate subsidence, but the geologic data from other sources (TH, MT and RT) primarily indicate uplift. Furthermore, the SH and RT samples are from the same geographic location. We next compare the geologic data to a smoothed GPS velocity field that was derived from a statistically robust interpolation technique that removes high-frequency non-tectonic noise (i.e., noise related to groundwater withdrawal). Our comparison with the interpolated GPS data, as well as each subset of geologic data, shows an increased correlation (R as high as 0.38) but overall the agreement is not strong (Figure 1). Therefore, the discrepancy in geologic and geodetic vertical data along SAFS is likely to be related to the measurement bias due to different sources of the geologic vertical motion rates in addition to the noise due to non-tectonic deformations in the geodetic data.

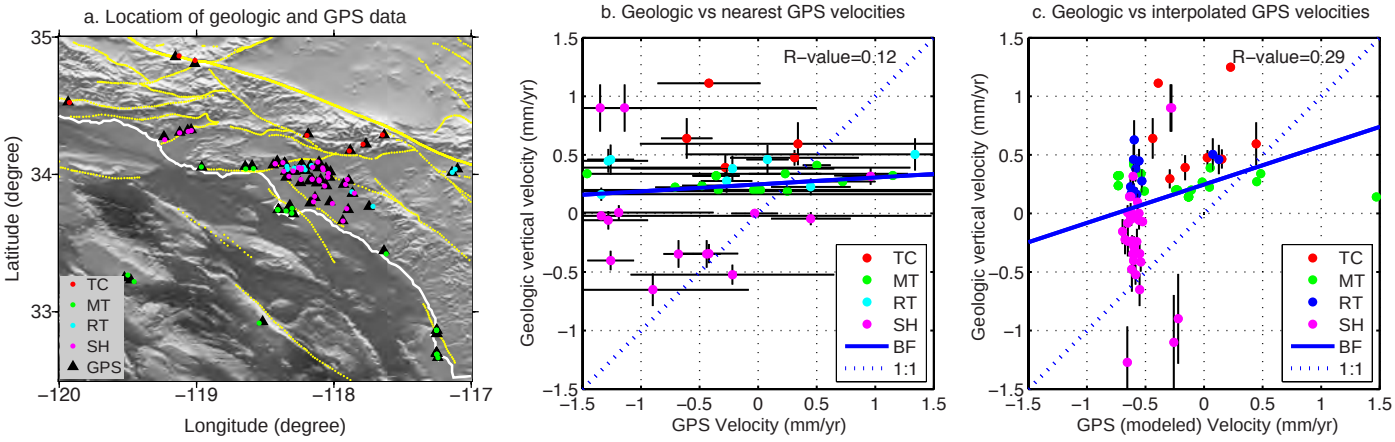

Figure 1. a) Location of geologic and geodetic data plotted in *b* and *c*. b) Scatter plot of geologic verses geodetic data and c) Scatter plot of geologic verses interpolated (modeled) geodetic data. The best-fit (BF) line is for comparison with the 1:1 line.