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Present-Day Vertical Motions of Tibet: Long-Term Tectonics, Short-Term Hydrology, And Other Causes?

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We use the present-day rates of vertical motions from GPS sites across the Tibetan Plateau and the surrounding area, in concert with measurements of horizontal motions and other data, to study the causes of these motions. Details of this vertical velocity field and its derivation are presented at this meeting by Yang et al. Present-day vertical motions include components from long-term tectonic uplift or subsidence, deformation related to the earthquake cycle, shorter-term hydrologic (loading) deformation, and anthropogenic effects such as groundwater extraction. Glacial isostatic adjustment may also contribute, depending on the scale of glaciation at the Last Glacial Maximum and the viscosity of the mantle beneath Tibet.

We estimate 6-8 mm/yr uplift in the High Himalaya and southernmost Tibet, decreasing to 2-3 mm/yr uplift in the Yarlung valley. The uplift peak agrees with earlier leveling observations in Nepal, and the uplift here is due mainly to interseismic strain from the locked Himalayan megathrust. We observe consistent subsidence across the region filled

with lakes in central Tibet, which is probably due to increasing lake and/or groundwater loading. Based on the GPS observations and modeling of GRACE data, we conclude that hydrologic loading deformation is a significant component of the present-day vertical velocity field. In the north and northeast edges of the plateau, uplift in Altyn Shan and Qilian Shan is 3-5 mm/yr or more is associated with rapid convergence at the edges of the plateau. Elsewhere on the plateau, most sites show slow uplift rates on the order of 1-2 mm/yr, while some areas bounding the plateau, such as the Sichuan basin, show subsidence.

The current GPS vertical velocity field in Tibet indicates that some published GIA models significantly overestimate present-day GIA uplift rates, which means that models featuring a large ice sheet covering Tibet during the last glacial maximum are not realistic.

Key words: GPS, uplift rate, Tibet

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