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Reconcile short- and long-term crustal deformation in the southwestern US

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Space-based geodesy has greatly refined crustal deformation in the southwestern United States, providing tight constraints on the driving forces. However, the short-term deformation based on the GPS measurements differs significantly from that derived from geological reconstruction. We have explored the dynamic links between short- and long-term crustal deformation in the southwestern US using a three-dimensional viscous finite element model. Our results suggest that the traction on the San Andres transform plate boundary alone can reproduce much of the GPS velocity fields, but the plate boundary force constrained by the GPS data cannot explain the long-term, geologically based deformation. The short- and long-term deformation can be reconciled in a model that assumes the traction on the plate boundary is higher during interseismic locking than the traction averaged over seismic cycles. We show that the present-day crustal deformation and stress field in the southwestern US can be explained by the balance of the plate boundary force and the gravitational buoyancy force. The same model, with the tractions on the San Andres fault a few MPa lower than those derived from the GPS data, produces close fits to the observed long-term deformation and stress orientations.