Text S1. GPS Methods.

First scientists at Jet Propulsion Laboratory estimate ≈24 satellite positions as a function of time and ≈80 site positions each day using phase center maps at the satellites and sites. They generate an X file on each day consisting of the rotation, translation, and Earth's scale that transforms the GPS positions into ITRF2005 [Altamimi et al. 2007]. The X files are available at ftp://sideshow.jpl.nasa.gov/pub/JPL_GPS_Products/Final . Next we estimate ≈7000 GPS site positions on each day using point positioning, that is, by fixing satellite positions as a function of time to their estimated values [Zumberge et al. 1997]. We resolve carrier phase ambiguities [using Ambizap, Blewitt 2008], thus reducing the dispersion in the position estimates.

Then we fit each GPS position-time series with an intercept (3 parameters, 1 for each component), a velocity (3 parameters), a sinusoid with a period of 1 year (4 parameters, 1 for each of 3 components and 1 phase), and offsets when needed (3 parameters for each offset). Assuming the phase to be equal for all 3 components means that, besides the velocity, the site is moving back and forth along a line segment.

We choose whether or not to estimate an offset in a manner consistent with that of Argus et al. [2010, see Appendix B.1]. Our criteria consist of (1) the size of the offset in mm, (2) the reduction in rms misfit in percent, and (3) whether or not there is a record of an antenna substitution in the log file. In general we estimate an offset if the estimate of the offset exceeds ≈10 mm in the vertical component or ≈5 mm in either the east or north component. (These threshold values are 25% greater than the median root mean square dispersion of 8 mm in the vertical and 4 mm in the east and north components.) In close cases we estimate an offset if there is a logged antenna offset, but do not if there is not. In most cases the offset reduces the root mean square dispersion of position estimates about the fit by more than 5%.

We assign sites to plates primarily on the basis of geological observations and secondarily on the basis of geodetic observations [Argus and Gordon 1996, Argus et al. 1999, 2010]. Using estimate of site velocity from places on plate interiors not near the late Pleistocene ice sheets, we simultaneously estimate the velocity of the plates and the velocity of the (CE) center of mass of solid Earth [Argus et al. 2007, 2010]. We assume that places on plate interiors not near the former ice sheets are, besides plate motion, moving negligibly in the horizontal relative to CE.

References

Blewitt, G. (2008), Fixed point theorems of GPS carrier phase ambiguity resolution and their application to massive network processing: Ambizap, *J. Geophys. Res. 113*, B12410, doi:10.1029/2008JB005736.

Zumberge, J. F., M. B. Heflin, D. C. Jefferson DC, M. M. Watkins, and F. H. Webb (1997), Precise point positioning for the efficient and robust analysis of GPS data from large networks, *J. Geophys. Res. 102*, 5005-501