Offshore Postseismic Deformation of the 2011 Tohoku Earthquake Revisited: Application of an Improved GPS-Acoustic Positioning Method Considering Sloping Sound Speed Structure

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One of the important issues on the GPS-acoustic (GPS-A) observation for sea bottom positioning is how to address the horizontal heterogeneity of the sound speed in oceans. We present an analysis method of GPS-A data in the presence of a sloping sound speed structure. By applying this method and revising the analysis scheme to make full use of existing data, we re-evaluated the horizontal postseismic deformations occurring ~1.5–5 years after the 2011 Tohoku earthquake. The revised horizontal movements have more uniform directions and rates between neighboring sites, suggesting enhancement of the array positioning accuracy. The revised displacement rate of the site on the incoming Pacific plate, located ~100 km northeast of the main rupture zone, was decreased significantly; it was only slightly, by 1.4 cm/year larger than the global motion of the Pacific plate, suggesting a relatively small effect of viscoelastic relaxation. The horizontal movements of the near-trench sites above the main rupture zone were generally landward and were significantly faster than the Pacific plate motion, indicating a viscoelastic relaxation of 5–10 cm/year. The distribution of the fast landward movements peaked near 38°N at an updip of the mainshock hypocenter and extended significantly farther to the north than to the south. This implies the existence of a secondary coseismic slip patch in the northern area in addition to a primary slip patch at ~38°N. The occurrence of episodic slow slip in early 2015 to the north of the main rupture zone was also verified from the GPS-A analyses.

Keywords: GPS-Acoustic observation, Postseismic deformation of the 2011 Tohoku earthquake

