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Monitoring postseismic motion of the frontal wedge after 2011 Tohoku Earthquake by across-trench acoustic ranging

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After the occurrence of the 2011 Tohoku Earthquake causing > 50 m coseismic slip at the shallowest portion of the plate boundary (e.g. Iinuma et al., 2012, JGR), evident postseismic deformation has been observed by seafloor geodetic observations. Fast postseismic displacement rates observed by GPS/Acoustic (GPS/A) measurements both on the landward- and oceanward-slopes of the Japan Trench can be by viscoelastic relaxation induced by the mainshock (e.g. Sun et al., 2014, Nature; Watanabe et al., 2014, GRL; Tomita et al., 2015, GRL). However, the prevalence of the viscoelastic relaxation makes it difficult to evaluate behavior of the shallow megathrust after the massive coseismic slip based on the available GPS/A data. It is expected that the relative motion of the frontal wedge against the incoming oceanic plate reflects the motion of the shallow plate boundary fault and we have been carried out seafloor acoustic ranging observations across the Japan Trench to monitor it.

Acoustic ranging measures two-way travel times between a pair of precision acoustic transponders placed on the seafloor. By repeating the measurements and after correcting for sound speed fluctuations, temporal change of measured travel time is converted to change of the baseline length. We have deployed instruments to make long-term continuous acoustic ranging across the Japan Trench, since 2013. Osada et al. (2014, JpGU) estimated the precision of the baseline length measurement to be several mm/year for 1 km baseline and proved that our acoustic ranging technique is capable of detecting seafloor motion at a rate of $\sim$ cm/year, equivalent to the expected rate of relative motions across the Japan Trench. Yamamoto et al. (2016, JpGU) reported no significant changes of the baseline lengths across the trench axis and suggested absence of afterslip on the shallow fault in the area.

In this paper, we show results of most recent deployment from September 2015 to September 2016 at the same region. In this observation, we remodeled the instrumental design to improve the measurement accuracy and allow continuous observation up to two years. With the new instruments, we successfully obtained continuous timeseries showing the relative motion across the trench for one year. The new results confirm that no significant shortening takes place, indication that the shallow afterslip does not occur by giving improved accuracy ($\sim$ 1 mm/year for 1 km baseline).

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