Trial of the crustal deformation detection accompanied with the tremor activities in Fukushima-Oki deduced from the ocean bottom pressure gauge data

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Recently, various phenomena of the slow slip events (SSEs) were detected in the Japan Trench. For example, Ohta et al. (2019) have detected low-frequency tremor activities in the Fukushima-Oki deduced from the Ocean Bottom Seismometer (OBS). They found the five tremor episodes with recurrence intervals of ~60 days which slow migration behavior and shear mechanisms consistent with plate subduction. They estimated the slip amount caused by these episodes based on the cumulative apparent moment of the tremor events as proposed by Hiramatsu et al. (2008). The apparent moment of the tremor was calculated on the basis of the ground displacement of the tremor seismograms and then converted to the seismic moment of the SSEs with an empirical scaling factor (Hiramatsu et al., 2008). The cumulative slip amount was roughly 1.5cm to 2.0cm. During the OBS observation, Tohoku University also developed the five Ocean Bottom Pressure-gauge (OBP) to detect the crustal deformation phenomena. In this study, we try to detect the crustal deformation accompanied with the tremor activities in this region.

Firstly, we assess the expected vertical displacement amount in the OBP sites. We assumed the fault model based on the results from Ohta et al. (2019). The fault area covered the area of the tremor activity, and the fault slip amount was assumed as 2cm which was based on the result of Ohta et al. (2019). The expected vertical displacement was approximately less than 1cm. This amount, however, may have the uncertainty because the slip amount may be affected by the value of the scaling factor which control the relationship between the seismic amount and apparent moment.

The obtained OBP time series will contain not only the crustal deformation but also the other contribution such as tidal component, non-tidal component, and specific sensor drift. Ocean tides were accounted for by harmonic analysis using the BAYTAP-G model of Tamura et al. (1991) and removed from the OBP time series. The model by Inazu et al. (2012) were applied to remove the non-tidal component. We fitted the drift model (Watts and Kontoyiannis, 1990) to each of the observed time series to estimate the drift function of individual sensors and removed from the time series.

Based on the obtained time series, we tried to detect the crustal deformation accompanied with the tremor activities. However, no significant displacement was detected from the OBP time series. This suggests that no crustal deformation has occurred beyond the current detectable accuracy of OBP. The current detectable accuracy of OBP is approximately ~1cm. If the 1cm displacement occurred at the OBP sited, roughly 5.7cm interplate slip is required. This is about 3.5 times slip amount suggested by Ohta et al. (2019).

Keywords: Ocean Bottom Pressure-gauge, Seafloor crustal deformation, Fukushima-Oki, Episodic tremor and slip, scaling

