Improvement in estimation of seafloor crustal deformation from ocean bottom pressure observations at the Hikurangi subduction zone offshore New Zealand

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Over the last decades, ocean bottom pressure gauges (OBPG) have been widely deployed in the world to measure seafloor crustal deformation from tectonic events, such as large earthquakes and slow slip events (SSE). However, any adequate technique, especially to detect SSE from OBPG data, has not been established, because oceanographic effects appeared on the OBPG data have not been fully understood and evaluated yet. One of the largest oceanographic components is an ocean tide. The ocean tide is composed of some periods. Long-period components with fortnightly and monthly periods have to be carefully evaluated and removed to detect SSE, because amplitudes and durations of them are similar to those from SSEs. In previous researches (e.g., Muramoto et al., 2019; Hino et al., 2014), however, the long-period tidal components have not been regarded. Here, we develop a novel approach to remove the long-period tidal components(fortnightly, monthly), and apply to detect SSE on the OBPG data in the Hikurangi subduction margin.
We apply BAYTAP-L (Tamura et al., 1991) to each of the OBPG records, in which make statistical estimation of long-period tidal component; all of tidal components are calculated by solving the penalty least square problems with Akaike’ s Bayesian information criterion (Akaike 1980), assuming smoothness of the component other than long tide on OBPG. Before applying the tide analysis, instrumental drift, non-tidal components calculated from a barotropic model (Inazu et al., 2012), and air pressure at the sea surface from atmospheric disturbances, are removed.
By removing tidal components less than monthly periods, the root mean square (RMS) of time series of the pressure decrease by about 10% of RMS from previous method, equivalent to 0.1hPa. We will estimate the uplift of the seafloor with fitting the linear and step function to the obtained time series and compare the results with the previously estimated values (e.g., Muramoto et al., 2019; Wallace et al., 2016). We will also discuss RMS of time series data with comparing multiple layer models, such as HYCOM(Bleck & Boudra, 1981) and ECCO2(Menemenis et al., 2008).

