Detection of seafloor crustal deformation from ocean bottom pressure data after applying amplitude corrections on non-tidal components in Hikurangi subduction margin

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Seafloor observation networks with ocean bottom pressure gauges (OBPG) are widely deployed to detect seafloor crustal deformation derived from tectonic events, such as slow slip events (SSE) now observed in many subduction zones worldwide. Data processing to detect SSE from OBPG data has, however, a serious issue, in which the observed pressure data as the height of the water column above OBPGs includes both the tidal and non-tidal components from oceanic mass shifts, as well as the tectonic components. Because the non-tidal component has amplitude and duration comparable to those of tectonic component, it should be removed from the observed data appropriately for detecting SSE. A global barotropic ocean model has been recently utilized to detect vertical displacement during SSEs from observed pressure data (e.g. Muramoto et al., 2019). Driven by assimilated surface wind vectors and air pressure at the sea surface from atmospheric disturbances (Inazu et al., 2012), the model simulates the total pressure field at the bottom of the sea. However, the modeled non-tidal components are not necessarily coincident with those of the observed records especially in amplitudes. We here propose a novel correction method to reduce the effect of non-tidal component on observed OBP records in the Hikurangi subduction margin.

To reduce the non-tidal component on observed data, we minimize differences between observed and modeled non-tidal components on OBPG data using amplitude correction factor. The observed and modeled components show high correlation with no phase difference, whereas their amplitudes are not completely consistent with each other; the amplitude of the modeled component is generally smaller than that of the observed one in the target area. After removing tidal components and instrumental drift with BAYTAP08 (Tamura et al., 2008), we calculate a correction factor that is a scaling factor of observed/modeled amplitudes of non-tidal components by minimizing the total residual between observed and corrected model amplitude. After multiplying the correction factor to the modeled one, we remove it from the observed OBPG data to reduce the non-tidal variations more effectively than previous works. As the results, variances of time series of OBP record after removal of tide and non-tidal components decreased ~ 30% at most. It is expected that detection ability of tectonic movement is improved by taking pressure differences from the record at a reference site, which is also processed by the same procedure.