On the Interpretation of oceanic variations in terms of ocean bottom pressure

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SSE is the phenomenon that rupture progress slowly compared with regular earthquake. Many examples are reported all over the world. (e.g. Yoshioka et al., 2004) Also, this phenomenon was observed before 2011 Tohoku earthquake. It is thought that deformation in the SSE area at the time of the main shock contribute to tsunami damage. (e.g. Ito et al., 2013) In general, the detection of SSE on the subduction zone, especially at the shallower part is difficult using only GNSS data. Therefore, the study for the sea floor crustal deformation observation and monitoring are receiving attention recently. Among them, the observation using Ocean Bottom Pressure Recorder is useful for observing crustal deformation due to SSE at a point where it can observe pressure change including vertical crustal deformation component in high resolution continuously. On the other hand, to extract the pressure change due to crustal deformation from Ocean Bottom Pressure Record, it is essential to understand exactly what caused the observed pressure change.
In this study, we consider about the factor of sea floor pressure change, especially temporal variation of several months to annual cycle from observed data. In this study, we use observed pressure records which spanned from June 2014 to June 2016 at off the coast of north island in New Zealand and Kumanonada using independent type Ocean Bottom Pressure Recorders. By using Baytap-G, we calculated the tidal component and subtracted it from the raw data. Then, we calculated sea-level anomaly (non-tidal oceanic variation) driven by air pressure and wind using barotropic ocean model. Comparing with Ocean Bottom Pressure Record after removing tidal component and calculated sea-level anomaly using ocean model, we found that there is a long-term component included in the Ocean Bottom Pressure Record that cannot be expressed by calculating ocean model. This long-term component’s amplitude is about 1.5hPa and has about a 90-day cycle. In evaluating the pressure change derived from crustal deformation due to SSE, the amplitude of this component we detected in this study cannot be ignored. In this study, we consider the origin of this tong-term component from multiple viewpoints such as gravity observation satellite GRACE or tide gauge record etc. As a result, we found that there is a “Fluctuation” which can be approximated as summation of harmonic mode. After subtracting the long-term component we identified in this study, we detected crustal deformation due to SSE at off the coast of north island in New Zealand. Then, we estimated fault slip due to the SSE from vertical displacement observed by Ocean Bottom Pressure and horizontal displacement observed by GNSS.

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