Estimating crustal movements during slow slip events from ocean bottom pressure gauge data using oceanic models

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1. Introduction
Ocean bottom pressure gauges (OBPs) can observe vertical movement of the seafloor continuously, and are useful to detect slow movement due to slow slip events (SSEs). The OBP data include components such as oceanic tide, oceanic variation, and instrumental drift. To detect crustal movements, these components must be removed. Shimizu et al. (JpGU, 2021) developed a method which conducts the Multi-channel Singular Spectrum Analysis (MSSA) for the observed data and an oceanic model, and divides into components, and then, only good correlation components of the oceanic model are removed from the observed data. This method can extract crustal movement better, because this method may remove incompleteness of the oceanic model. This study estimates crustal movements due to SSEs by applying this method to a renewal oceanic model.

2. Method
The renewal oceanic model is MOVE/MRI.COM-JPN Dataset developed by MRI, JMA (Hirose, et al. 2020). The OBP data are obtained at off Boso Peninsula from 2013-2015, and 2016-2018 which include the 2014 and 2018 Boso slow slip events.
From the observed data, we remove the oceanic tide using Baytap08 (Tamura et al. 1991), and remove the drift using a linear fitting. We conduct the MSSA for the removed data and the oceanic model data, and calculate correlation between them for each component. We reconstruct oceanic model data using only good correlation components, then remove them from the removed data. Then, to estimate crustal movements due to SSEs and seasonal deformation, we fit a parametric model (Sato et al. 2017) to the residual between the removed data and the reconstructed oceanic model.

3. Results
The observed data matches the renewal oceanic model better in comparison with the old model. The residual between the removed data and the reconstructed oceanic model has standard deviation of 1.81 hPa. On the other hand, the residual between the removed data and the renewal oceanic model itself has 2.41 hPa. This suggests that the present method can remove oceanic variation better. Fitting the parametric model to the residual between the removed data and the reconstructed oceanic model, we obtain standard deviation of 0.76 hPa. The estimating vertical movements due to the 2018 SSE are 14.8 mm(−1.49hPa) at uplift area.

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