Comparison of Ocean Bottom Pressure Observation Timeseries with Result of Real Ocean Estimating Models around the Pacific Rim Earthquake Zone

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Ocean Bottom Pressure gauge observation (OBP) has an ability to detect centimeter scale seafloor vertical deformations near the plate boundaries. However, timeseries of OBP contain not only crustal deformation signal but also ocean tide or other oceanic variations, so detection of vertical displacements from OBP variation is not easy task. Especially, non-tidal oceanic variations have common timescale (several days to weeks) with seafloor deformations related to slow earthquakes which have different features from usual earthquake we know. Therefore, removing non-tidal oceanic variations is demanded and one possibility to solve this question is estimating the non-tidal oceanic variations by real ocean estimation model simulations. Actually, this method has already applied to some observation areas.

In this research, we used two realistic ocean estimation models and evaluated how these can reduce the amplitude of non-tidal oceanic variations by applying to multiple ocean area around the Pacific Rim Earthquake Zone.
We introduced a data assimilated product, ECCO (Estimating the Circulation of the Ocean assimilated by JPL) in addition to the single layer-barotropic ocean model (Inazu et al, 2012) and compared these two calculation result with observed OBP time series. In this comparison, we collected OBP timeseries mainly from IRIS Data Management Center and Ocean Networks Canada including Hikurangi Subduction Zone, Cascadia Subduction Zone and Chile Trench.

As a result, we can see the different characteristics of two models and timeseries variation of each sites and evaluate the variation amplitude because 1hPa change means 1cm change in seawater height and seafloor vertical displacement. In case of Hikurangi subduction zone, ECCO can reduce OBP amplitude about 15-25% and standard deviation of after correction is 1.5-2.5 (hPa), and single layer-barotropic ocean model can reduce OBP amplitude about 30%-40% and standard deviation after correction is 1.1-1.8 (hPa). In case of south area of Cascadia subduction zone, the reducing rate is common to each model about 5-15% which isn't so high as Hikurangi subduction zone however standard deviation after correction is 0.9-2.0 (hPa) which is almost same as after correction of Hikurangi subduction zone but in north area of Cascadia subduction zone, standard deviation after correction is 1.6-2.6 (hPa) though two model can reduce amplitude10-20%.
This implies that using model is effective at Hikurangi site and also Cascadia subduction zone is suitable site to detect centimeter scale seafloor vertical deformation from the viewpoint of simple amplitude variation analysis.

Keywords: Crustal deformation, Ocean Bottom Pressure , Physical ocean modeling