Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SCG62-02 Room:303 Time:May 27 14:30-14:45

Estimation of fault parameters of slow slip event, off the Kii Peninsula, detected by DONET

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The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) installed permanent ocean bottom observation stations named as Dense Oceanfloor Network System for Earthquakes and Tsunamis (DONET) off the Kii Peninsula to monitor earthquakes and tsunamis. We derived the component of sea floor change from the ocean-bottom pressure record, and we detected the ocean-bottom pressure changes, starting from February 2013, at a part of stations deployed to DONET (Suzuki et al., 2014). These pressure changes were synchronized with a decrease in the background seismicity within the area of a nearby earthquake cluster. Although we considered that these pressure changes show the vertical sea floor changes due to the crustal deformation caused by slow slip event (SSE), we did not estimate the fault parameters of SSE. Therefore in this study we tried to estimate the parameters of the fault slip that caused crustal deformation.

In this study we estimated the fault parameters of SSE by comparing the observed vertical displacements with ones calculated by the fault model using the dislocation source solutions (Okada, 1992). In Suzuki et al. (2014), we derived the vertical crustal deformations from the ocean-bottom pressure changes as described below. First we removed the tidal component from the ocean-bottom pressure records by BAYTAP-G (Tamura et al., 1991). Next we subtracted the average of pressure change taken over the records at stations connected to each science node from the records removed tidal component in order to remove the pressure changes due to atmosphere pressure changes and non-tidal ocean dynamic mass variation. Therefore in this study we subtracted the average changes from the each theoretical displacement when we calculated the theoretical displacements by using the fault model.

Although there are nine parameters in the fault model, we observed vertical displacements at only four stations. Therefore we cannot uniquely determine the fault parameters, and we need to constrain the fault parameters in the inversion process. In this study we supposed the plate boundary and splay fault in the sedimentary wedge as the fault that caused crustal deformation. In the plate boundary case, we fixed the strike, dip and rake, and estimated other parameters by grid search method. However we made the fault depth to be coincident with the plate boundary depth. On the other hand in the splay fault case, we estimated the fault depth and dip by the grid search method in addition to parameters estimated in the plate boundary case. However fault depth was constrained in the shallower part than the plate boundary depth.

Although we explain the relative vertical displacement pattern in the plate boundary case, the average displacement taken over the stations is large. If this large average displacement actually occurred, we could detect it from the pressure gauge records removed tidal component. Therefore it is difficult to explain the observed displacements by using the fault model along the plate boundary. On the other hand in the splay fault case, the average displacement is small and the calculated relative displacement pattern is coincident with observed one. Therefore the splay fault case is more reasonable to explain the observed vertical displacements. In the future we will consider the fault model having other type mechanisms and investigate the relationship between the fault slip and the seismicity change.

Keywords: DONET, ocean bottom pressure change, slow slip event, seismicity change