Spatiotemporal evolution of interplate slip in the Hyuganada and the Bungo Channel from 1996 to 2000 based on GNSS data

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The Philippine Sea plate is subducting beneath the Amurian plate along the Nankai trough in southwestern Japan. In the western end of this area, the Bungo Channel and Hyuganada, it is known that afterslip and slow slip events (SSEs) occur on the plate interface. For example, in the Hyuganada region, afterslip follows two M 6.7 earthquakes in 1996 (e.g., Yagi et al., 2001) and repeating SSEs occur in the afterslip area (Yarai and Ozawa 2013), and SSEs repeatedly occur in the Bungo Channel (e.g., Hirose et al., 1999). Previous studies analyzed spatial and temporal slip history of a part of these events. For example, Yagi et al. (2001) showed the spatial slip distribution of the afterslip and Ozawa et al. (2007) studied the afterslip and an SSE around the Bungo Channel around 1997. However, few studies estimate the spatiotemporal slip history in the entire region between 1996 and 2000, the time period for which these slip events took place. Therefore, the purpose of this study is to estimate aseismic slip evolution in Hyuganada and the Bungo Channel , and to propose the occurrence of an SSE in 1998 in the afterslip area.

We use daily coordinates of GEONET GNSS stations processed by Geospatial Information Authority of Japan (GSI) (F3 solutions; Nakagawa et al., 2009). Coordinate time-series data at 47 stations in Kyusyu, Shikoku and Chugoku areas for the period between September 1, 1996, and June 1, 2000 are analyzed. We estimate a common-mode time-series that is calculated by 21 stations for the same period to remove noise of 47 stations. After remove common-mode, a secular liner component of these stations estimated by the period from October 1, 1998 to June 1, 2000, coseismic jumps and artificial steps caused by station maintenances are removed from these stations. We assume a geometry of the plate interface on the subducting Philippine Sea plate estimated by Shiomi et al. (2008) and Nakanishi et al. (2018), and the interface geometry is represented by 11 ×21 small square subfaults whose area is 13 ×13 *km2* for each. We apply a time-dependent inversion method (Hirose et al., 2014) to the preprocessed data to estimate a spatiotemporal slip evolution on the plate interface.

Three slip events are resolved. First event is a slip around Hyuganada started from around September 1996 and continued to October 1997. Second event is a slip around Bungo Channel continued from around January, 1997 to March, 1998. Third event is a slip around Hyuganada continued from around May in 1998 to March in 1999. First event corresponds to the afterslip of the two Hyuganada earthquakes. However, although the first earthquake in Hyuganada occurred on October 19, 1996, this event began from around September 1996. Probably, this is because the inversion contains temporal smoothness. Second event corresponds to the 1997 Bungo Channel SSE. We can divide the slip into three region spatially that are southwestern Shikoku, northeastern Bungo Channel and southwestern Bungo Cannel, because the slip distribution and the development of seismic moment show migrations of SSE two times. Seismic moment of the slip around southwestern Shikoku increased from around January to April in 1997, and the slip migrated to southwest after April. The slip around northeastern Bungo Channel started from around May in 1997 and seismic moment continued to increase until around November in 1997. The slip of this region expanded and migrated to southwest for the period of increasing seismic moment. Seismic moment of the slip around southwestern Bungo Cannel increased for the period between around September and December in 1997. Third event is smaller area than the afterslip of Hyuganada in 1996 but almost same location. The slip of this event is about 10cm. Seismic moment of the slip is 6.0×10^{18} N/m (Mw=6.5). Yarai and Ozawa (2013) detected repeating SSEs in this region after 2005, hence the detected slip in 1998 is a likely predecessor of the Hyuganada SSEs.

We estimate the spatiotemporal evolution of aseismic slip in Hyuganada and the Bungo Channel, especially the afterslip of the two Hyuganada earthquakes and the Bungo Channel SSE in 1997 and an SSE in the afterslip area. We found that (1) slip migrations of the Bungo Channel SSE two times; and (2) an SSE occurrence in 1998, which is a predecessor of the reported Hyuganada SSEs after 2005 (Yarai and Ozawa, 2013).

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