Spatiotemporal slip distributions of the 2018-2019 Bungo Channel long-term slow slip event

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We estimated the spatiotemporal slip distributions of the long-term slow slip event (L-SSE) that occurred beneath the Bungo Channel from 2018 to 2019, by using the GNSS time series data operated by Geospatial Information Authority of Japan.
In this region, the Philippine Sea plate is subducting beneath the Amurian plate in the northwest direction at a rate of about 6.5 cm/yr. At the plate boundary beneath the Bungo Channel, aseismic interplate long-term slow slip events, which are hereafter referred to as L-SSEs, have occurred repeatedly with durations of several months to a couple of years. From previous studies, L-SSEs beneath the Bungo Channel have been identified to take place at intervals of about 6 years such as the events that occurred during the periods from 1997 to 1998, from 2002 to 2004, and from 2009 to 2011.
We used the daily coordinate values (F3 solutions) of GEONET and 114 GNSS observation stations in western Shikoku and eastern Kyushu for the period between January 1, 2016 and June 30, 2020. We set six stations as reference stations located in the northern Chugoku district, which were not affected by crustal deformations associated with the L-SSE. The GNSS time series data include coseismic steps, steps caused by antenna exchange, common-mode errors, and annual and semi-annual components. We removed these components to investigate crustal deformation associated with the L-SSE. We approximated tectonic deformation associated with plate motion as a liner function and removed its trend. The data period used for its calculation was taken from January 1, 2016 to December 31, 2017. After that, we employed an inversion method with three prior constraints: the spatial slip distribution was smooth to some extent, the slip directions were mostly oriented in the direction of plate convergence, and the temporal change in slip was smooth to some extent (Yoshioka et al., 2015). The data period used for the inversion analysis was taken from January 1, 2018 to December 31, 2019. We divided the time series into an equal time span of 0.1 yr.
As a result of the inversion analysis, the maximum slip of about 27 cm, the moment release of 3.7×10^{19} Nm, and equivalent moment magnitude of 7.0 were estimated. The slips can be divided into two slip stages. The first slip occurred on the southwest side of the Bungo Channel from 2018.3 to 2018.7. The maximum slip, moment release and equivalent moment magnitude were estimated to be about 10 cm, 8.9×10^{18} Nm, and 6.6, respectively. The maximum slip velocity was estimated to be about 36 cm/yr during the period from 2018.5 to 2018.6. The second slip took place beneath the Bungo Channel from 2018.8 to 2019.4. The maximum slip, moment release and equivalent moment magnitude were estimated to be about 19 cm, 2.0×10^{19} Nm, and 6.8, respectively. The maximum slip velocity was estimated to be about 53 cm/yr during the period from 2019.1 to 2019.2. After the second slip, slight slip occurred beneath the Bungo Channel from 2019. 5 to 2019.7.
Tectonic tremors appear to have been activated on the downdip side of the L-SSE occurrence region when large slow slips occurred beneath the Bungo Channel.
As described above, the first slip occurred on the southwest side of the Bungo Channel, and the second slip took place near the center of the Bungo Channel. Compared to the L-SSEs that occurred beneath the Bungo Channel in the past, this spatiotemporal slip pattern was similar to that of the L-SSE that occurred from 2002 to 2004. However, the difference is that the interval between the first slip and the second slip was shorter, and that the slip expanded in the northeast-southwest direction in the latter half of the

second slip. The moment release was almost the same, but the maximum slip and the maximum slip velocity were larger. This may be related to a slight increase in the interval from the last L-SSE occurrence.

Keywords: Bungo Channel, 2018-2019, long-term slow slip event, spatiotemporal slip distribution

