Application of a slow slip objective detection method

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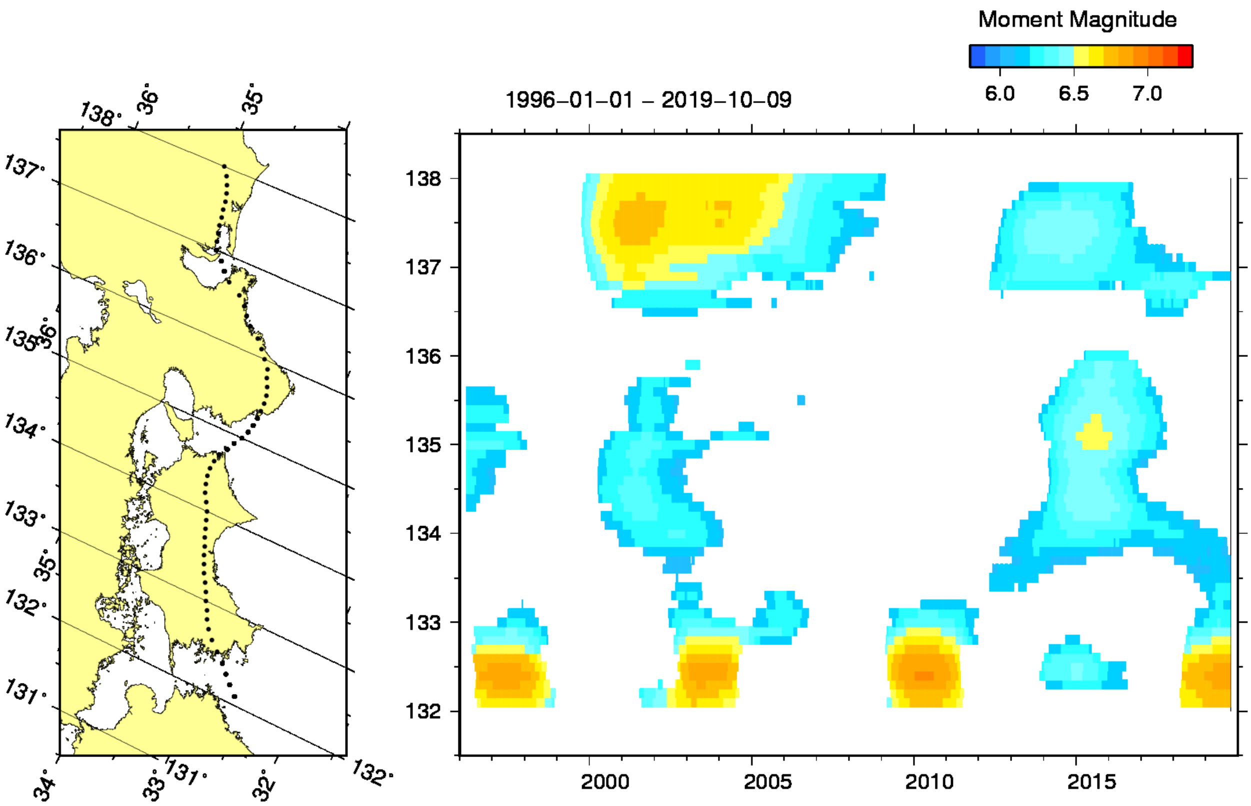
In the Nankai Trough, slow earthquakes such as short-term slow slip events (SSEs) and long-term SSEs have been observed. Kobayashi (2017) developed a method for objective detection of long-term SSEs and revealed their spatiotemporal distribution. Here, we tried to estimate the approximate magnitude of long-term SSEs by applying this method.

We used the daily coordinates of the GEONET F3 analysis operated by the Geospatial Information Authority of Japan. We removed linear trend, coseismic and artificial offsets. Chugoku region is close to the Nankai Trough and relatively stable without the influence of long-term SSEs. The median of the coordinates in the Chugoku region was calculated every day and that value was subtracted from the coordinates of all stations. The latitude of the 25-km depth contour of the Philippine Sea plate in the Nankai Trough region was derived at intervals of 0.1° from longitude 132.1°E to 138.0°E, yielding a line of 60 points. A rectangle measuring 100 km in the direction of plate subduction and 50 km in width, closely matching the strike of the Nankai Trough, was centered on each of the 60 points, and data from the GNSS stations within each of these rectangles were extracted. For each rectangle, the component of motion in the opposite direction from plate subduction was calculated from the mean of the horizontal components of the stations within the rectangle. Then, we obtained cross correlations with a ramp function with 1-year gradient period and change before and after the period.

We assumed a 100 mm slip on a 30 km x 30 km rectangle fault (equivalent to Mw 6.3) centered on the 60 points of the 25-km depth contour. Then, the component of motion in the opposite direction from plate subduction was calculated from the mean of the theoretical displacement of the stations within the 100 km x 50 km rectangle. Assuming that the dimension of the rectangle fault is fixed and only the amount of slip changes, the magnitude of slip was estimated from the ratio of the 1-year change to the theoretical mean displacement.

The magnitude of the long-term SSEs was estimated at Mw 6.3-6.9 at the peak of each event. Except for the Tokai 2000-2005 SSE, these are roughly consistent with the previously analyzed results. Although the duration of Tokai 2000-2005 SSE is long, this method estimates the magnitude per year, so the difference may be large.

Keywords: long-term slow slip event, Nankai Trough, GNSS


Moment Magnitude
6.0
6.5
7.0
1996–01–01 – 2019–10–09
138
137
136
135
134
133
132
2000
2005
2010
2015
138°
137°
136°
135°
134°
133°
132°
131°
36°
35°
34°
33°
32°