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The 2011 Boso slow slip event

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There occurred four slow slip events (SSE) offshore of the Boso peninsula in 1996, 2002, 2007, and 2011 with a recurrence interval of 4 to 6 years. In all cases, it took approximately 10 days for the Boso SSEs to subside. In addition, the past four Boso SSEs occurred in similar areas, indicating characteristic behaviors as was observed in ordinary earthquakes. In this research, we estimate spatial and temporal evolution of aseismic slip of the four Boso SSEs by time dependent inversion.

The GPS network detected transient crustal deformation on the Boso peninsula in 1996, 2002, 2007, and 2011. The detected transient displacements subsided for approximately 10 days. To emphasize transient displacements, we removed a steady deformation from the raw time series. The detrended crustal deformation shows south-southeastward displacements. The maximum detrended deformations are 1.c cm in May 1996, 2.5 cm in October 2002, 2.2 cm in August 2007, and 3.9 cm in November 2011.The observed transient deformation is thought to be caused by the Boso Slow Slip Events (Boso SSE)

We employed time dependent inversion to the detrended crustal deformation associated with the Boso SSEs. We used EW, NS, and UD components of crustal deformation at approximately 40 GPS sites relative to Yasato station. The plate geometry of the upper surface of the Philippine Sea plate is based on Nakajima and Hasegawa [2006]. The fault geometry is expressed by superposition of B-spline functions and slip on the fault is also composed of superposition of B-spline function. Trend and annual components are removed from the raw time series as mentioned above. As boundary condition, we set 0 slip on the edge of a fault geometry.

The results show that the slow slip started offshore of the Boso peninsula and expanded to the south over time in the 1996, 2002, 2007 and 2011 cases. In the case of the 2007 event, slow slip also expanded to the north. The estimated moment magnitudes are 6.7 in 1996, 6.7 in 2002, 6.7 in 2007 and 6.9 in 2011. A similar area was ruptured by the four Boso SSEs with a similar magnitude and a rupture process. The recurrence interval is 6.39 year from 1996 to 2002 events, 4.86 years from 2002 to 2007 events, and 4.28 year from 2007 to 2011 events. The four events do not seem to be slip predictable nor time predictable. Though the 2011 event shows the largest magnitude among the four cases, recurrence interval from the 2007 event is the shortest. We cannot rule out a possibility that the Tohoku earthquake may have affected the occurrence of the 2011 event. In fact, dCFF increased near the rupture area of the Boso peninsula from the Tohoku earthquake.
We will investigate a stress state change in the peripheral area of the 2011 Boso SSEs.

Keywords: Boso peninsula, slow slip event