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Transient slow slip event revealed from ocean-bottom seismic and geodetic observations in the Japan Trench

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In the Japan Trench, which is characterized by an active plate margin, the seismic coupling coefficient in the entire seismogenic zone of the plate boundary is $\sim$25%. Fast convergence (8 cm/yr) of the Pacific plate subducting beneath the landward plate makes the seismicity along this plate boundary the highest in the world. The relatively low seismic coupling coefficient suggests that much of the interplate motion in the seismogenic zone is accommodated by stable aseismic slip or transient slow slip that compensates for the lack of seismic coupling. Here we show a transient slow slip event on the plate boundary in the Japan Trench. The transient crustal deformation, which occurred over 7 days, as simultaneously measured using ocean-bottom pressure gauges and an on-shore volumetric strainmeter simultaneously, has been interpreted as an M 6.6 slow slip event on the plate boundary with a slip magnitude of 0.14 m. The relationship between the seismic magnitude and the duration of the slow slip event fits well with the scaling law for slow earthquakes. The rupture propagates along the fault strike with a speed of 7 km/day, which is consistent with the rupture propagation speed of other slow slip events. These results suggest that slow slip events are controlled in the same physical manner as slow earthquakes in other subduction zones. Furthermore, the slow slip event preceded an M 6.1 interplate earthquake for two weeks. Our findings indicate that the slow slip event induced an increase in shear stress, which in turn caused the interplate earthquake in the subduction zone. In general, the aseismic slip in subduction zones with low coupling coefficients may be accommodated with transient slow slip events rather than stable aseismic slip, and they could act as a triggering event for interplate earthquakes in seismic regions.