

## Periodic slow slip and megathrust zone earthquakes in northeastern Japan

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Both aseismic and seismic slip accommodate relative motion across partially coupled plate boundary faults. In northeastern Japan, aseismic slip occurs in the form of decelerating afterslip following large interplate earthquakes and as relatively steady slip on uncoupled areas of the subduction thrust. Here we report on a new quasi-periodic slow-slip behavior that is widespread in the megathrust zone. The repeat intervals of the slow slip range from 1 to 6 years and often coincide with or precede clusters of large ( $M \geq 5$ ) earthquakes, including the M9 Tohoku-oki earthquake. The examination of the spatio-temporal distribution of small repeating earthquakes with respect to the  $M \geq 5$  earthquakes suggests that the slow-slip pulses trigger the  $M \geq 5$  seismicity. These results suggest that inherently periodic slow-slip events result in periodic stress perturbations and modulate the occurrence time of larger earthquakes. The periodicity in the slow-slip rate has the potential to help refine time-dependent earthquake forecasts.

Keywords: slow slip, repeating earthquakes, interplate earthquakes