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Effect of long-term SSE and megathrust earthquake on tremor activity

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Tremor activity migrates with a velocity of ∼10 km/day along the strike of subducting plate boundary. Recently it has been shown that migration front draws a parabolic pattern in spatio-temporal distribution of tremors, indicating that tremor migration is diffusional process [Ide 2010]. We analyzed activities from 2001 to 2013 in western Shikoku, and obtained diffusion coefficients on the order of 10^4 m^2/s for all the activities. Relatively large values ($>1.5\times10^4$ m^2/s) were obtained for the activities during long-term slow slip events (SSEs) in the Bungo Channel region or just after the 2011 Tohoku earthquake (SSJ2013). In this study we investigate the relation between these activiteis and external stress perturbations.

To evaluate perturbations due to these events, we calculated Coulomb stress changes (ΔCFF) using Coulomb 3.3 [Toda et al. 2011]. The long-term SSEs in 2003 and 2010 produced ΔCFF of 28.7 and 5.4 kPa, respectively. These values are large enough to affect tremor occurrences because they are on the same order of magnitude as the tidal effect, which modulates tremor occurrences. The Tohoku earthquake produced ΔCFF of 0.4 kPa. Although it is smaller than the tidal effect by an order, a long-time stress change due to possible viscoelastic response would give some effect on tremor occurrences. Since such a stress perturbation is widespread on the plate interface, it could accelerate tremor migration observed as high diffusion coefficient. We also compare tremor activities with the seismicity calculated with a rate- and state-dependent friction law.

Keywords: deep non-volcanic tremor, tremor migration, Coulomb stress change, long-term slow slip event, megathrust earthquake, subduction zone