

## Slow slips with durations between VLF and short-term SSE

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Various types of slow earthquakes have been observed so far. Their durations vary from 0.1 s to about one year. However, there have been no report on slow earthquakes with durations between those of VLE (very low frequency earthquake) and short-term slow slip event (SSE). VLFs have characteristic periods of about a few tens of seconds. Short-term SSEs have durations of a few days to a week. We searched for slow earthquakes with durations from minutes to one day with data obtained with laser extensometers and bore-hole strain meters, and found slow slips with one hour duration.

We calculated correlation coefficients between ramp functions of various rise time with observed strain data with shifting time. Polarity of the ramp function was set based on calculated strain assuming slip directions. Then we accumulated the correlation coefficients from each strain channel. The time series of accumulated correlation function showed some peaks. Many of them seems to be due to some noise. However, some of them were consistent with plate boundary slip. Slow slips of one hour duration were found while a short-term slow slip was proceeding in February, 2019 (upper panel of the figure). The slip corresponded to moment magnitude of about 5.0. In the figure, the red line indicates calculated strain. It is considered that this is a temporary speed-up of the short term slow slip event. This is similar to occurrence of deep low-frequency earthquakes and VLF during a short-term SSE. We found similar events during SSEs since 2015. Ide et al. (2007) pointed out existence of a scaling relationship among slow earthquakes (lower panel of the figure). The newly found one-hour duration slow slip (the star in the lower panel graph) is consistent with the scaling relationship by Ide et al. (2007).

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