

Automatic detection of slow slip events based on GPS data

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Recently, slow slip events have been reported by continuous GPS observation. We could not detect slow slip events from seismological observation because they do not produce seismic signals. In Japan, slow slip events have reported at Boso peninsula in 1996 and 2002, Bungo channel in 1997 and 2003, and off Choshi in 1999. In western Shikoku, simultaneous occurrence of low-frequency tremors and tilt changes are reported in 2001 and 2002, indicating slow slip events. Detection of slow slip events is a big problem because the amount of GEONET data is so huge and the related coordinate changes are so tiny. We developed a new technique to detect slow slip event efficiently. We used daily routine coordinate solutions of GEONET by the Geographical Survey Institute, and processes those data as follows. (1) A linear trend and seasonal signals are estimated from daily coordinate changes and subtracted from the original data to obtain residual time series. (2) The common residual is calculated by averaging the residual time series for all the stations in the network, and subtracted from each residual time series to reduce noise level (network filtering). (3) The time of a slow slip event is specified by the correlation analysis between the residual time series and a N-shape correlator. (4) Plot the correlation value of each station with different colors on the map.

With this method, we can find slow slip events from temporally as well as spatially coherent pattern to correlation values. Artificial effects such as GPS antenna changes can be distinguished from slow slip events because spatial pattern is incoherent. As a result of our analysis, we detected slow slip events at Boso Peninsula and Bungo Channel. But slow slip event at eastern Shikoku synchronized deep low-frequency tremors were not detected so far. A possible explanation is that the associated displacement is too small (less than 2mm). To solve the problem, it may be effective to change analysis region and to test various functions for the correlation analysis.