A Trial of Automatic Detections for Possible Crustal Deformation Signals in Strain and Tilt Data

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Slow earthquakes have occurred repeatedly along the Nankai subduction zone. Geodetic signals of slow earthquakes with duration of ~1 week are called short-term slow slip events (S-SSEs). Moment magnitudes of S-SSEs observed in the Southwest Japan usually range between 5.5 and 6.0. Ground surface displacement of those S-SSEs are close to noise level of GNSS data, which prohibits detailed analysis of S-SSEs with GNSS data except for large events. Instead, S-SSEs are monitored with strain data maintained by National Institute of Advanced Industrial Science and Technology and Japan Meteorological Agency and Hi-net tilt data maintained by National Research Institute for Earth Science and Disaster Resilience, which are more sensitive to small ground deformation. However, due to its high sensitivity, those data also often record non-tectonic crustal deformations by barometric pressure changes, rainfalls, and so on, making it difficult for us to interpret those data. To explore signals of S-SSEs in strain and tilt data, we usually refer tectonic tremor catalogs, which accompany S-SSEs, though it is not always the case. For example, tremors do not accompany S-SSEs in Ise-Bay region. Hence, a new method automatically detecting possible signals of crustal deformations, which are not limited to S-SSEs, without referring other information than strain and tilt data. This study presents our new trial at Shikoku region.

Our method is based on Nishimura et al. (2013, doi:10.1002/jgrb.50222), which detects S-SSEs using GNSS data by calculating ΔAIC between the model fitting only a linear function and the model fitting a linear function and a ramp function. Although they used only along-dip components, we calculate average ΔAIC for all available components at each stations as we do not limit our target to S-SSE. We search where and when the spatio-temporally coherent signals are observed over the network using ΔAIC. As a result, we found that large peaks of ΔAIC usually corresponds to regular local earthquakes, S-SSEs (including potential events, which are not reported so far by AIST), or heavy rainfalls.

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