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First detection of the 2009 slow slip event under northeast Taiwan at the Ryukyu subduction system from continuous GPS data

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Transient fault slip episodes have been documented with continuously-recording GPS instruments located at several subduction margins on the Pacific Rim due to the fluid released from the dehydration of the subducted oceanic crust. A slow-slip event is detected from June 2009 to October 2009 based on the analysis of coordinate time series from 22 continuous GPS stations in northeastern Taiwan, belonging to the backarc extension region of the Ryukyu subduction zone. The GPS data from 2006 to 2011 were processed using GAMIT software and the common-mode errors were removed from the coordinate time series by the spatial filtering. The accumulative displacement pattern shows the displacement direction towards SSE with the maximum value of $\sim$9 mm. The accumulative slip distribution and fault geometry parameters are inverted by surface accumulative displacements using the uniform stress drop inversion. The optimized model indicates a reverse fault plane with a shallow dip angle of $\sim$10° and a depth of $\sim$10 km. A maximum of 4.4 cm of slip is inferred near the southeastern part of the study area. However, the tomography study results indicate that the depth of subduction interface in northeastern Taiwan is $\sim$30-40 km and the dip angle is $\sim$30°-40°, much deeper and steeper than our inferred fault plane. In addition, the northeastern Taiwan has been thought as a westward extension of the Okinawa through with an ultra-rapid collision-induced clockwise rotation of $\sim$ 29.5° $\pm$ 3.1°/Myr in the present. In the same time, several nearly east-west-striking seismogenic zones develop and mainly act as left-lateral strike-slip faulting and normal faulting accompanying the opening of the backarc basin. The bottom depth of these seismogenic zones is $\sim$10 km, corresponding to the depth of our inferred fault plane. This may suggest a new shallow north-dipping thrust between the interface and the shallow seismogenic zones in northeast Taiwan. The relationship between this slow slip event and other regular large earthquakes in this region will be studied soon.