Potential of Megathrust Earthquakes along the Southern Ryukyu Trench Inferred from GNSS Data

*Masayuki Kano[1], Aoi Ikeuchi[1], Takuya NISHIMURA[2], SHINICHI MIYAZAKI[3], Takeshi Matsushima[4]

1. Graduate School of Science, Tohoku University, 2. Disaster Prevention Research Institute, Kyoto University, 3. Graduate School of Science, Kyoto University, 4. Faculty of Science, Kyushu University

The southern part of the Ryukyu subduction zone has recorded tsunami events with a recurrence interval of several hundred years. Although their source is controversial, one model suggests that the last 1771 Yaeyama tsunami was caused by a shallow megathrust earthquake with a magnitude of 8. However, the current knowledge on interplate coupling based on recent geodetic data is limited.
Here, we analyzed a time series of Global Navigation Satellite System data from January 2010 to February 2021, including newly installed stations by Kyoto and Kyushu Universities, to obtain the distance changes between stations and vertical secular velocities. The distance changes ranged from 2.4 mm/yr in contraction and to 4.7 mm/yr in extension, and the vertical velocities exhibited no clear uplift or subsidence, with -2.4 to 1.1 mm/yr.
The back slip inversion results indicated a slip deficit of 17–47 mm/yr to the south of the Yaeyama Islands. The large slip deficit area is complementarily intervened between the shallower source area of low-frequency earthquakes and the deeper slow slip region, suggesting the spatial heterogeneity of frictional properties along the plate interface. If the large slip deficit area accumulates stress in the same rate since the last 1771 earthquake, it could result in a megathrust event with a moment magnitude greater than 7.5. Because the limited onshore data cannot resolve the slip deficit on the shallow plate interface, seafloor geodetic observations are essential to clarify the detailed spatial distribution of the slip deficit and discuss its earthquake and tsunami potential.

Keywords: Ryukyu subduction zone, Interplate coupling, Slow earthquakes, GNSS

