Geophysical Research Abstracts
Vol. 21, EGU2019-7405-1, 2019
EGU General Assembly 2019

Identification of seismogenic zones from GNSS data: an example of Kyushu Island, Japan

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To identify a possible seismogenic zone from GNSS-based surface deformation data, we should find an incoherent boundary in the velocity field across which material lines are discontinuous. With LSC (Least Square Collocation) method and triangulation method with relatively small segments, it is difficult to find incoherent boundaries, although high strain-rate zones can be recognized with these methods. High strain-rate zones, however, are not necessarily seismogenic zones (e.g., An et al., 2018, Abstract [T33D-0427] presented at 2018 Fall Meeting, AGU). Here we show an example of Kyushu, Japan where the seismogenic MTL (Median Tectonic Line) is an incoherent boundary in velocity field. We located the fixed point of the velocity field along the MTL to lessen the effect of translating component on the velocity field near the MTL. Then we divided Kyushu into two areas to the north and south of the MTL since these two areas show velocity fields remarkably different from each other. The patterns of velocity fields in the northern and southern areas are general shearing (pure shearing combined with simple shearing) and pulsating or super-simple shearing (simple shearing combined with rigid-body rotating), respectively. We calculated the average velocity gradient tensor and Wk (kinematic vorticity number) of each area, using triangulation method with large segments covering each of the entire areas. Wk of the northern and southern areas are 0.16 and 1.08, respectively. The deforming pattern of the southern area (pulsating shearing) is of particular interest since any location in the southern area is suffering a periodic straining and unstraining. The reason for the difference in deforming pattern of the two areas is unclear at present. One possible reason is that the deformation of the northern area is influenced mainly by the Himalayan collision while that of the southern area is controlled mainly by the convergence of the Philippine Sea Plate with the MTL acting as an accommodation boundary. One important question is how can we efficiently recognize incoherent boundaries in a velocity field calculated from GNSS data?