Crustal deformation of the 2016 Kumamoto earthquake sequence (6)
– Postseismic deformation (viscoelastic model) –

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A large intraplate earthquake with a moment magnitude of 7.0 occurred on April 16, 2016. Large displacements induced by this earthquake were observed by the GNSS and SAR data (Yarai et al., 2018, this meeting). Postseismic deformation following this earthquake is also observed by GNSS and SAR data (Kobayashi, 2018, this meeting). In this study, we report a viscoelastic and afterslip postseismic deformation model, based on the observed GNSS and SAR data. We first consider a viscoelastic only model, then subtract its effect from the observations, and then estimate an afterslip model.

Viscoelastic relaxation is dependent on the viscoelastic structure and the viscosity. In this study, we assumed a simple two-layered model, which consists of an elastic layer and an underlying Maxwell viscoelastic layer. We searched two viscoelastic model parameters which are an elastic thickness and a viscosity to be in the range between 10 and 40 km and 1.0×10^{18} and 1.0×10^{19} Pa·s, respectively. Studies of postseismic deformation reveal that afterslip may generally dominate near-field motions for as long as short term (a few months), but viscoelastic relaxation generally dominates at all distance in the longer term. Therefore, we used the sites that are located in distance from 50 to 150 km of the rupture zone and the data on and after 6 months after the mainshock to constrain the viscoelastic model parameters. Optimal value of elastic thickness and viscosity is estimated to be 25 km and 2.0×10^{18} Pa·s, respectively. Viscoelastic relaxation produces westward displacements and uplift in and around the east Futagawa fault. In contrast, southward motions and subsidence dominate in and around the Hinagu fault.

After removing the viscoelastic effect, the deformation concentrated in the focal area. Using this data, we estimate an afterslip model by forward modeling with changing the amount of slip to minimize the RMS in horizontal components. The results revealed that amount of slip concentrated on the Hinagu fault, whereas the coseismic slip concentrated on the Futagawa fault. The other characteristic is that the slip is estimated on the north-east extent of Futagawa fault with SE dipping plane.

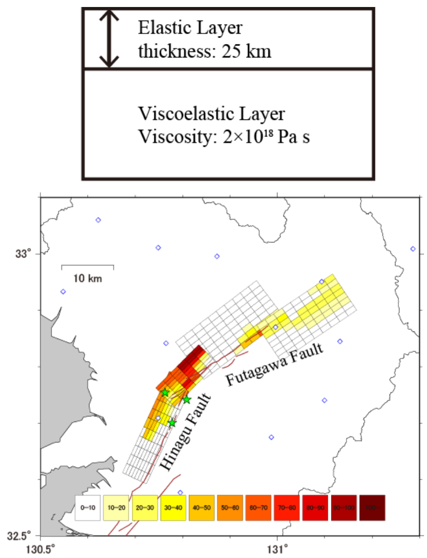

Figure 1. Optimal parameters of viscoelastic model (Top) and estimated afterslip distribution (Bottom).

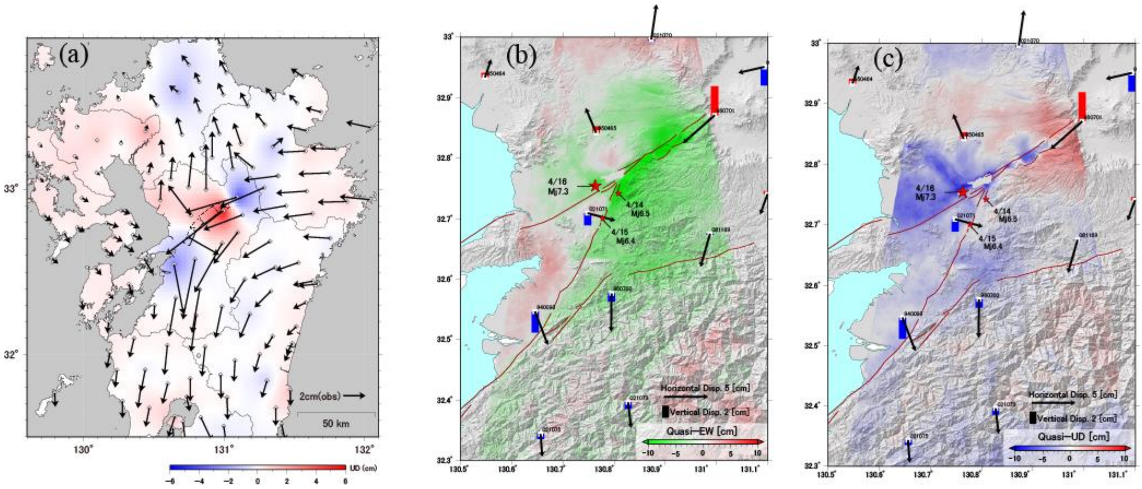

Figure 2. Observed postseismic deformation for 1 year based on (a) GNSS, (b) InSAR in quasi-EW component and (c) InSAR in quasi-UD component.

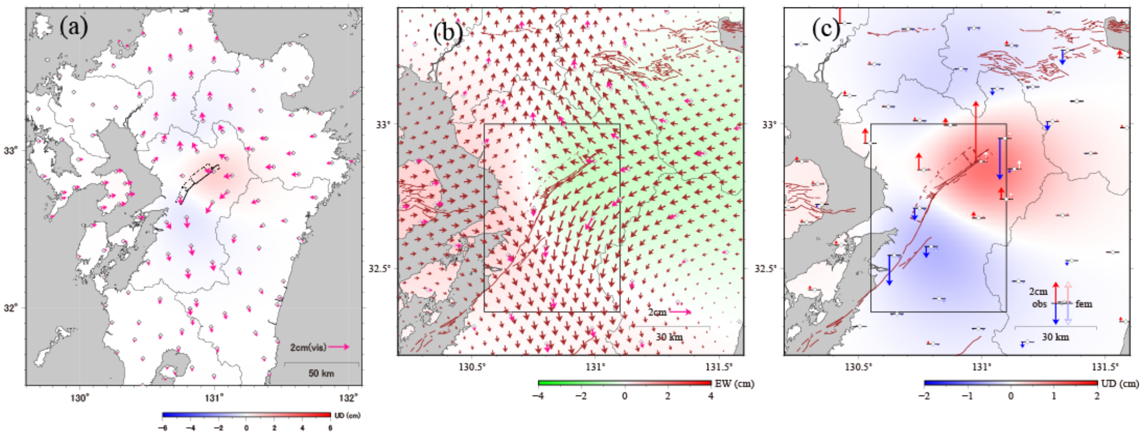

Figure 3. Computed postseismic deformation caused by viscoelastic relaxation based on optimized model. (a) Horizontal and vertical, (b) Horizontal and EW component and (c) Vertical component.

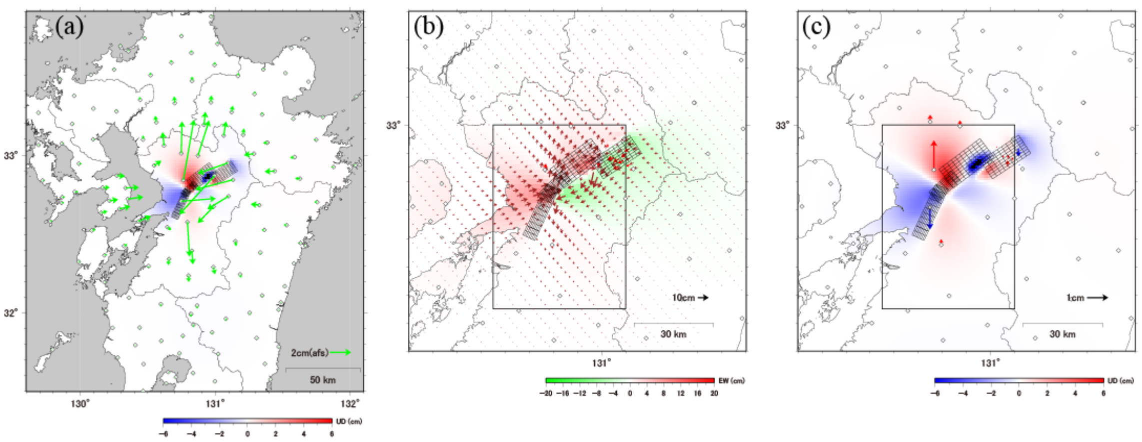

Figure 4. Computed postseismic deformation caused by afterslip. (a) Horizontal and vertical, (b) Horizontal and EW component and (c) Vertical component.