Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS30-P07 Room:Convention Hall Time:May 25 18:15-19:30

Source process analysis of the 1923 Kanto earthquake using 3-D Green's functions and a curved fault model

YUN, Sunhe[1*] ; KOKETSU, Kazuki[2] ; KOBAYASHI, Reiji[3]

[1]Earthquake Research Institute,The University of Tokyo/Itochu techno-solutions, [2]Earthquake Research Institute,The University of Tokyo, [3]Graduate School of Science and Engineering, Kagoshima University

The Kanto earthquake occurred on September 1, 1923 (UTC). The source region included the land area, causing severe damage in the Kanto district. This is an inter-plate earthquake along the Sagami trough. Large seismic intensities were observed not only around the source region but also in areas far from there. This strange distribution was caused by a 3-D complex structure of the Kanto basin. We calculated Green's functions using a Japan integrated velocity structure model by Koketsu et al. (2008) to include effects of the Kanto basin on ground motions and we performed source process inversions of the Kanto earthquake. This model reflects a 3-D complex shape of the Kanto basin and sedimentary layers are more than 3 km under the Tokyo bay and the northern Chiba prefecture. The dataset consists of static displacement, teleseismic, and strong motion data. We adopted both the same fault model as used by Sato et al. (2005) and a curved fault model. For the latter model we reconfigured the depths following the plate boundary.

We first calculated Green's functions using a half-space medium, a 1-D and a 3-D velocity structure model. The 3-D Green's functions are larger and longer than others and amplified later phases are remarkable. This means soft and 3-D complex sedimentary layers amplify Green's functions. We performed source process inversions using these Green's functions and geodetic data. All results show the similar large slip areas. But the total seismic moment of the result using 3-D Green's functions is the smallest. This implies amplifications by the basin also affect source process inversion results of only geodetic data. Next we used 3-D Green's functions and performed a joint inversion of static displacement, teleseismic, and strong motion data with the plane fault model. The large slip areas are similar to the result of Sato et al. (2005) but our result shows smaller slips and a smaller total seismic moment. In addition, we could obtain inversion results that provide good agreement in the later parts of the strong motions. We finally used 3-D Green's functions and performed a joint inversion with the curved fault model. The results show the western large slip area is moved to the southwest on the shallow part of the plate boundary, where is far from the hypocenter. Our result with the curved fault model shows larger slips and a larger total seismic moment than our result with the plain fault model. This is because the depths of the curved fault model are deeper, so Green's functions are smaller.

The results by the plane fault model and Sato et al. (2005) obtained the western large slip area where many aftershocks occurred. But our result with the curved fault model obtained the western large slip area where relatively a few aftershocks occurred. This is coincident with previous researches about the relationship between slip distributions and aftershock distributions. On the other hand, both the results with the plane and curved fault models show similar rupture propagations. The rupture started at a protruded area on the plate boundary and propagated to shallow southern parts for the initial 20 s. Then the rupture propagated to eastern areas where the plate boundary is dented for the next 20 s.

This study indicates that a velocity structure should affect not only strong motions but also static displacements for earthquakes occurred beneath the Kanto basin, which has thick sedimentary layers and a 3-D complex velocity structure. As a result, source process inversion results using a half-space and 1-D velocity structure models may overestimate slips and total seismic moments. In addition, we could obtain inversion results that provide good agreement with strong motions. This indicates the significance of using 3-D Green's functions in source process inversions. And the result with the curved fault model shows the slip distribution agrees with the established theory on aftershock patterns and a main shock faulting.

Keywords: source process inversion, 3-D Green's function, Kanto basin