

Preliminary results of dynamic rupture simulation of the 2023, Kahramanmaras and Ekinozu, Türkiye, earthquake sequence

*Ryosuke Ando¹, Ali Pinar², Dogan Kalafat², Haluk Ozener², Yojiro Yamamoto³

1. Graduate School of Science, University of Tokyo, 2. KOERI, Bogazici University, 3. JAMSTEC

The 2023, M 7.8, Kahramanmaras earthquake (mainshock) occurred on February 6th mainly along the plate interface called the East Anatolia fault, followed in 9 hours by the M 7.6, Ekinozu earthquake (largest aftershock) hosted by the subsidiary fault system called the Cardak –Surgu faults. This earthquake sequence presents significant complexity, including the following features. The strikes of these faults differ by about 30 degrees, while they commonly have dominant sinistral slip sense. The observed hypocenter indicated that the mainshock rupture nucleated away from the East Anatolia fault and was probably located on a subsidiary fault called the N-S striking Narli fault. Strong ground motion records suggested that the rupture initially propagated toward the northeast and then switched to the southwest. While the faults hosting these two major earthquakes appear connected, the observed hypocenter of the second earthquake was located more than a few tens km away from the junction of these faults. To understand the tectonic condition and underlying physical mechanism generating this earthquake sequence, we performed a set of stress tensor inversion and dynamic rupture simulations. The 3-D fault geometry is built based on the previously compiled surface fault traces (<https://github.com/GEMScienceTools/gem-global-active-faults>) and assumed constant dip angles. The fully elastodynamic BIEM accelerated by FDPM (FDP-BIEM) is employed by using 128 nodes of Earth Simulator for 1 hour to conduct a single run of the simulations. Based on the stress inversion using the aftershock focal mechanisms ($M > 4$), we first find that the maximum horizontal principal stress axis around the Cardak –Surgu faults is slightly rotated clockwise from that around the East Anatolia fault. Next, we find that the Narli fault and the East Anatolia fault are favorably oriented against the inverted regional stress field. Finally, the simulation can reproduce that the rupture nucleated on the Narli fault can propagate to the East Anatolia fault. We will discuss the mechanical interactions between the mainshock and the largest aftershock.

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