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GNSS-derived Coseismic Displacement of the Gökçeada Earthquake (2014, Mw:6.9) based on 1 Hz GNSS Data

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GNSS technology has been extensively used to measure crustal deformation and widely used to construct displacement waveforms. GNSS seismology uses GNSS receiver as displacement seismometer for earthquake studies. In other words, it can sense large dynamic displacement without saturation. In GNSS, relative positioning method requires a reference station with no-motion whereas Precise Point Positioning (PPP) method does not need any reference station. However, PPP method, unlike relative positioning method, requires readily precise GNSS satellite orbit and clock product calculated beforehand to perform absolute positioning using a single GNSS receiver data. In case of large earthquake, it may be crucial to select stable reference for relative positioning. Therefore, in order to monitor ground motion pattern caused by the earthquake, PPP method is advantageous because it provides absolute coseismic displacements with respect to a global reference frame.

In this study, we investigate the pattern of coseismic displacement and velocity of the Gokceada (Turkey) earthquake (United States Geological Survey M=6.9, May 24, 2014 - 09:25:02 UTC). One hertz of 8 continuous GNSS stations, part of CORS-TR network, were processed using PPP and relative positioning techniques to estimate epoch-by-epoch positions of the sites. The epicenter distance of GNSS stations are ranging from 90 km to 250 km. CSRS-PPP and GAMIT-Track tool software were used for PPP and relative positioning solution, respectively. We analyze the ground motion characteristic of GNSS-derived displacement and velocity. Results show that the travelling time of earthquake wave for each station increased with respect to epicentral distance. Results also demonstrate that the shaking amplitude generated by the earthquake decreased while epicentral distance increased. Peak to peak displacement of the closest station to epicenter is around 10 cm and 5 cm for north and east component, respectively. For selected farthest site, peak to peak displacement is around 5 cm and 3 cm for north and east component, respectively. Arrival time difference of earthquake wave between closest and farthest sites used in this study is around 50 sec. In this paper, we also compare PPP-based displacement/velocity to relative positioning-based displacement/velocity. The result demonstrated that the PPP based solutions shows good agreement with that of the relative positioning solutions in terms of the ability to capture coseismic displacement.