

Surface rupture and coseismic deformation associated with the 2014 Nagano-ken-hokubu earthquake revealed from differential LiDAR analysis

*Daisuke Ishimura¹, Shinji Toda¹, Sakae Mukoyama², Shinichi Homma²

1.Disaster Science Division, International Research Institute of Disaster Science, Tohoku University, 2.KOKUSAI KOGYO CO., LTD.

The Nagano-ken-hokubu earthquake occurred on November 22, 2014, along the Kamishiro fault, one of the segments of the Itoigawa-Shizuoka Tectonic Line active fault system. A 9-km-long surface rupture associated with the earthquake indicates a N-NW trending, east dipping fault extended to the hypocentral depth. We mapped the surface rupture and measured the amounts of vertical and horizontal displacements (Okada et al., 2015; Ishimura et al., 2015). However, due to the limited time allowance until winter snowfall starting from December, we could not homogeneously observe ground deformation along the Kamishiro fault. We thus employ differential LiDAR analysis to reveal precise location of surface rupture and coseismic displacement.

The data sets we used for the analyses are 1 m mesh DTM (Digital Terrain Model) data measured in 2009 (pre-event), 2014 (5 days later from the event), and 2015 (about 1 year later from the event). We applied the particle image velocimetry method to obtain 3-D vectors of coseismic deformation (Mukoyama, 2011). The precision of this method is ~0.1 m.

The result shows a clear contrast of vertical displacements and horizontal vector directions between hanging wall and foot wall sides. The locations of these contrasts are corresponding with our field observations (Okada et al., 2015; Ishimura et al., 2015) and let us know missed surface ruptures. From these results, we confirmed the surface ruptures composing of two or three bow-shaped traces. Vertical displacements at some points are larger than the field measurements, indicating underestimates at the field due to wide warping zone. Horizontal displacement was detected at the extending part of the surface rupture, corresponding with InSAR results.

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