# Seismic signal analysis of the 2011 landslide in Misakubo, Shizuoka prefecture and the potential for the real-time landslide detection

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When Typhoon Talas moved through western Japan on September 3-4, 2011, there were heavy rainfalls across a wide region in central and western Japan. There were extensive slope failures in the Kii peninsula, which killed 97 people. In Shizuoka prefecture, the total rainfall during the week exceeded 1000 mm. Although the damage is less severe than the Kii peninsula, the heavy rainfall triggered a large landslide in Misakubo-town, Tenryu-ward, Hamamatsu city, Shizuoka prefecture. The landslide was detected by the Japan Air Self-Defense Force on September 7, 2011. The field survey to analyze the landslide dam was performed on the next day.

We applied the triad array method (Fan et al., 2018, GJI) to detect and locate seismic sources using F-net and TW arrays (Okuwaki and Fan, 2019, AGU). The signal from the Misakubo landslide was recorded at 6:07 PM, September 4, 2011. The location error between the estimation and field survey is about 6 km. We also performed the long-period seismic waveform inversion with the same dataset. The result shows the estimated volume is about 2 million ($m^3$) and the movement of the landslide is from east to west. These movement mechanisms are consistent with the field survey result.

Seismic signals from landslides are generated less efficiently than from earthquakes. Due to their small amplitude, the signal is difficult to be observed in the period range of microseisms (5-20 s). Therefore, the signals tend to be observed clearly in the short period range (a few Hz), or long period range (20-50 s). The short-period signals are more sensitive to smaller events, but signal attenuates faster than long-period signals. Therefore, near-source stations within the limited distance range can record the signals. They will be useful to locate an event with higher precision. The long-period signals have little influence from a velocity structure, so the signals are more coherent over the longer distance. In general, landslides larger than 1 million ($m^3$) are recorded by the seismic network in Japan. The combination of these short-period and long-period seismic signals will be useful for the real-time detection of landslide events.

Keywords: landslide, seismic waveform, Misakubo-town