



## **Uncovering a landsliding process by using Surface-wave method and Structure from Motion photogrammetry**

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The prediction of landsliding motion is important to plan their mitigation works. Landsliding processes are, however, various, often quite complicated and unpredictable. To clarify the internal structure of landslides effectively and to observe landsliding motions expeditiously are needed to understand landsliding processes. A landslide appeared on farmland in April 2016 in Rikubetsu, Hokkaido, Japan. This landslide caused a characteristic bulge topography at its terminal end, destroying the farmland and altering the flow of a river. The dimension of the bulge had already reached around 80 m long, 30 m wide and 3 m high when it was found. The bulge grew for a year and then stopped no later than May 2017. We applied Surface-wave method (SWM) and Structure from Motion (SfM) photogrammetry for the bulge to understand the landsliding process and observe the landsliding motion, respectively. SWM captures the form and depth of a rupture surface below the bulge. A SWM profile traversing the bulge draws a low-velocity zone around 5 m depth, which is gently inclined upwards towards the front edge of the bulge. A drilled core sample, recovered at the bulge top, contains a clayey layer with shear structures, the depth of which corresponds to the low-velocity zone. We collected aerial photographs around the bulge using a small unmanned aerial vehicle several times and generated digital surface models (DSMs) from SfM photogrammetry. A time series of DSMs indicates that the bulge expanded upwards and forwards overall and its maximum height reached around 4 m high by May 2017, and the expanding almost stopped at this time. During this landsliding motion, the terminal position moved little. The form and depth of the rupture surface and the observation facts indicate that the bulge grew with forming a fault-propagation fold. Mitigation works need to consider the landslide structure, because if the bulge is removed, the landslide can be reactivated.