

Debris flow monitoring using load cells system in Sakurajima Island

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PREVIOUS DEBRIS FLOW MONITORING

Many debris flows have recently taken place frequently in Sakurajima Island due to rainfall events after falling volcanic ash by volcanic activities since 2010, and the number of debris flow occurrences has gradually increased though volcanic activities were active in 1980s there and the numbers of debris flows occurrences decreased in 1990s to 2000s due to decreasing volcanic activities. For countermeasure against debris flow hazards and sediment management after debris flow events, various kinds of measurements have been carried out to understand the flow characteristics of debris flows. In those monitoring, temporal changes of flow depth and discharge and bed profiles tried to be collected using ultrasonic sensors and video camera, and profiles of bed elevations were also collected near river mouth in the sea using a sounding machine to evaluate sediment runoff volume from river mouth. Sediment in debris flow bodies tried to be measure using a sampler box produced by iron bucket. However, it was difficult to obtain continuous data for sediment discharge and the runoff volume due to debris flows.

DEBRIS FLOW MONITORING IN ARIMURA RIVER AND NOJIRI RIVER

Nojiri River is southern-west area in Sakurajima, and is with a watershed area 2.99 km², bed slope

4.5 % and flow width 13.2 m at the Nojiri 1st sabo dam (Fig. 1). Arimura River is in southern-east area in Sakurajima, and is with a watershed area 1.35 km², bed slope 19% and flow width 20.5 m at the Arimura 3rd sabo dam (Fig. 2). If several rivers which debris flows take place frequently are chosen, the number of debris flow occurrences in Arimura River has gradually increased: e.g., 6 times in 2010, 6 times in 2011 and 9 times in 2012, and 18 times in 2010, 10 times in 2011, 21 times in 2012 and 18 times in 2013 in Nojiri River. A modified monitoring system, which is firstly proposed in Switzerland (McArdell et al., 2007), using load cells and a steel plate was installed to clarify flow characteristics of debris flows at the Arimura River 3rd sabo dam in June in 2012 (Osaka et al., 2014). Debris flows are observed by the newly installed debris flow measurement system with loadcell and pressure sensor (DFLP), and sediment concentration of both coarse sediment phase and suspended & liquid phase can be estimated by the DFLP (Osaka et al., 2014). After the installation in Arimura River, a system with small size of loadcell and steel plate without accuracy change of measurements was discussed for easier maintenance against mechanical troubles, and the newly modified three systems with a steel plate (1 m in width and 1 m in length) was developed and installed transversely at the 1st sabo dam

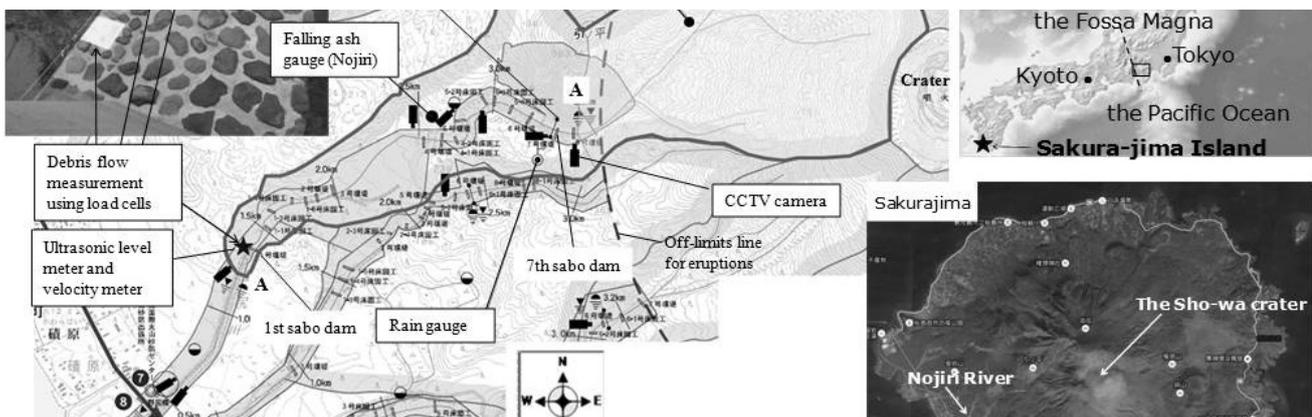


Figure 1. Debris flow monitoring equipments installed in Nojiri River basin

on March in 2013. In order to measure occurrence and runoff of debris flow, many sensors have been installed (Figs. 1 and 2), and those are as follows: Rain gauge, X-band MP rader, ultrasonic water level meter, radio wave velocity meter, wire sensor, falling ash gauge, acceleration vibrograph and CCTV camera in Arimura and Nojiri River. In Arimura River, debris flow took place 13 times in 2014, and debris flows with middle magnitude were observed on June 27th, July 30th, August 29th and November 1st, and debris flows on June 27th were obtained by DFLP systems. While, in Nojiri River, debris flow took place 17 times in 2014, and debris flows with middle magnitude were observed on May 14th, June 21st, June 27th, July 9th, August 1st and November 1st. Debris flows on June 21st and 27th were measured by three DFLP systems in Nojiri River.

In present study, temporal changes of specific weight, sediment concentration and sediment volume of debris flow using DFLP systems in Nojiri and Arimura Rivers in 2014 were shown. Sediment concentration and specific weight were calculated such as 0.552 (left side), 0.667 (center), 0.816 (right side) and 1.94 (left side), 2.13 (center),

2.38 (right side), respectively, in Nojiri River (June 27th, 2014). In Arimura River, sediment concentration and specific weight are calculated as 0.463 and 1.76, respectively, in debris flow (June 27th, 2014)

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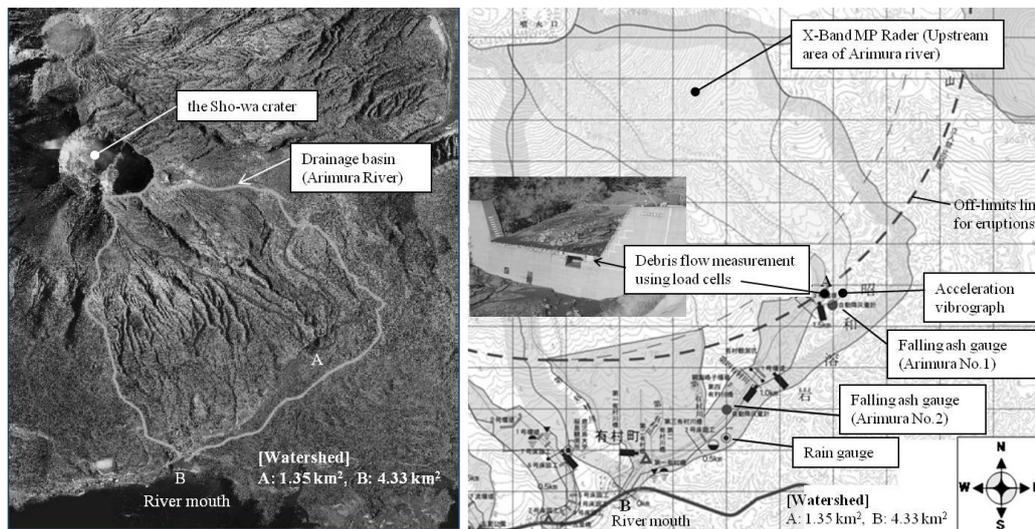


Figure 2. Debris flow monitoring equipments installed in Arimura River basin

KEYWORDS

debris flow; monitoring; Loadcell system (DFLP); Sediment concentration; Specific weight of debris flow

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