Influence of grain-size distribution on formation of debris-flow fan

Haruka Tsunetaka, Norifumi Hotta, Yuichi Sakai, Yuki Nishiguchi, Junya Hina

1. Life and Environmental Sciences, Tsukuba University, 2. Graduate School of Agricultural and Life Sciences, The University of Tokyo, 3. Construction Technology Institute Co., Ltd.

Accurate prediction of debris-flow fan formation is critical to sediment disaster mitigation because most damage from debris flow occurs in the inundation area. Although actual debris flows include a diversity of grain sizes, assessment is generally based on numerical simulation results for monogranular debris flows. This study conducted flume tests of debris flows using 0.08 m$^3$ of sediment particles that were either monogranular (2.65 mm) or a mixture of seven diameters (0.7 to 6 mm; average size of 2.65 mm) and compared formation processes of debris-flow fans to examine the influence of grain-size distribution. Channels (15°, 10 cm wide) with a deposition area (12° to 6°) were used for the experiments. We captured the development of the debris-flow fans using photographs and videos made by digital cameras and used the techniques of Structure from Motion (SfM) and Particle Image Velocimetry (PIV) to monitor debris-flow fan formation and flow regimes. As a result, monogranular debris flows produced an approximately symmetric debris-flow fan. In contrast, multigranular debris flows produced an asymmetric debris-flow fan, and the topography and range differed in each case. These results suggest that grain-size distributions of debris flows affect the process of debris-flow fan formation.

Keywords: Debris flow, Debris flow fan, Flume test, PIV, SfM