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Morphometric impact and sedimentation process during lahar at Merapi Volcano, Indonesia

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Most of geomorphological researches discuss significant topographic changes after lahar events. Their deposits are often used to interpret sedimentation processes. However, the lack of detailed direct observation during lahar events leads to some controversies about existed geomorphological and sedimentological theories. This research presents debris-flow-type lahars on February 28 and March 18, 2014 at Merapi volcano in Indonesia. This chronological study of morphometric impact and sedimentation process associated to lahar flow dynamics were conducted in the frame of the SEDIMER Project (Sediment-related Disasters following the 2010 centennial eruption of Merapi Volcano, Java, Indonesia). We deployed a station at Gendol River (4.6 km south from the summit) consisting of an automated camera and a high definition camera, respectively on true left and right side of the river. We also installed 3 axes yellow landmarks of 2 m long. A laser rangefinder was used to perform cross sections of the channel. The results showed that the first lahar transformed a flat riverbed into another with a deep incised thalweg. The second lahar eroded the thalweg even deeper and created a cascade when touching lava flow deposit. Lahars consisted of 5 phases (run off, hyperconcentrated flow, peak of debris flow, lahar body, and lahar tail). Important topographic changes occurred within the peak of debris flow phase, containing 3 sub-phases (front, rising limb and recession limb). The lahar front exhumed boulders on the channel floor. The laminar flow of the rising limb was reinforced by agitations and hydraulic jumps. The recession limb was more smooth, leading to massif sedimentation. Lahar body and lahar tail phase caused riverbed erosion and several thin sedimentation layers on top of recession limb deposit associated to their flow waves. The sedimentation process was aggradation progressive. One of the lahar videos is accessible online on VHUB cyberinfrastructure platform (<https://vhub.org/resources/3910>).