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Bashkara glacier lake outburst flood (Central Caucasus, Russia) on September 1, 2017: numerical modelling vs. field-based assessment

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During the night of September 1, 2017, a disastrous debris flood occurred in the valleys Adylsu and Baksan (Mt. Elbrus area, Kabardino-Balkaria Republic, Russia). There were three casualties. More than 3.4 km of the highways were destroyed and damaged. About 8000 local people and tourists were blocked without transportation, power supply and telephone connection. There was no gas supply in six settlements. According to the official data the cost of the emergency and reparation works amounted to 10 mln EUR.
The debris flood was caused by the outburst of the Bashkara glacier lake. The burst has been triggered by abnormal rainfall in combination with strong overmoistening of a loose material. The volume of the liquid phase of the flow was about 1 million m3, volume of solid phase entrained along flow path was about 0.35-0.5 million m3. We also note that similar amount of rain has been registered 3 times since 2008, but moraine dam was stable. Besides rainstorm lowering of the Bashkara glacier surface disturbed dam stability and amplify effect of rain.
The Bashkara glacier lakes have been monitored since 1999, repeated bathymetric surveys were performed using echo-sounder, water level was measured automatically by different gauges. The geophysical survey was performed on the Bashkara glacier snout. An automatic weather station is located at the distance of 500 m from Bashkara Lake. Increase of outburst probability and hazard has been reported in many studies. Numerical simulation of potential GLOF has been realized in FLO-2D software and reflects situation which observed ten years ago. Considering that lake has been dammed by moraine dam and glacier snout it was proposed that lake will drain through englacial channels.
According to field data gathered immediately after event, the real outburst scenario was differed from the proposed one. Moraine dam was destroyed by erosion and flow travelled through glacier surface. The availability of detailed data on the Bashkara GLOF allowed us to perform the debris flow simulation. High resolution DEMs before and after event were generated from SPOT-6 and Pleiades stereo pairs, consequently.
RAMMS:DEBRISFLOW and STREAM-2D software were used for simulation. According to the modelling, we assumed the mudflow was the water-stone type, had speeds of up to 6 m/s on average and density about 1450 kg/m3. Modelled flow velocity, depth and inundation area correlate well with observed values, but the results from RAMMS software were better than from FLO-2D and STREAM-2D. RAMMS is more suitable for the modelled conditions, since it takes into account the slope steepness, turbulence and flow viscosity in mountains. The other models, originally developed for water flows in plains, require more careful calibration and cannot fully take into account mountain conditions.
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