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Assessing a large-scale debris flow in Barsem, Tajikistan: exceptional size, duration and process chain

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Large-scale debris flows often include multi-hazard conditions. Such a large-scale event occurred in Barsem, Gorno Badakshon Autonomous Oblast (GBAO), Tajikistan in July 2015. A total volume of approximately 4.2 million m3 of debris was eroded and transported from a periglacial source (at 4,250 m a.s.l.) down to Barsem Village (2,350 m a.s.l.). An in-depth field investigation, interviews with local villagers of Barsem, analysis of digital elevation models (before and after) and an analysis of videos, photos and satellite imageries revealed unexpected outcomes: the events lasted for nine days, a total of 30 to 40 individual surges were reported and the erosional cross-section along the 7 km long channel was of extraordinary size (up to 1,700 m2).
The presentation will highlight the results of the detailed analysis of pre-conditions in the starting zone (long- and short-term perspective) and the triggering mechanism of the several debris flow surges. A major lake outburst (GLOF) could be excluded as trigger, however, exceptional weather conditions prevailed prior and during the events as well as permafrost degradation contributed to trigger the event.
A further special focus will be on the changing accumulation and erosion pattern from the starting zone along the channel to the newly built debris fan in the valley. The results reveal that the high number of different interactions and permanent changing conditions of the geomorphic processes during the events lead to the overall multi-hazard situation including the new fan of more than 3 million m3, which subsequently dammed the Gunt River to a 2-km long lake.
This study provides insights in the trigger and sequence of high-magnitude low-frequency events, and may be useful for the assessment of similar conditions and future events originating in periglacial high mountain environments.

Keywords: large-scale debris flows; multi-hazard; sediment dynamics; Tajikistan