Glacier hazards in the Andes: features and global context

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Global climate change leads to accelerated glacier wastage in the majority of alpine areas worldwide. Glacier decrease rate in the Andes has been one of the highest in the world during recent decades. Together with neotectonic, seismic and volcanic activity this brings glacier hazard in the region to a top level. High density of population worsens the situation. Just in the tropical Andes glaciers have killed about 50000 people in 20^{th} century. Among the world deadliest five glacial disasters, four took place in the Andes, of them three in Cordillera Blanca. Careful study of glacier hazards in the Andes region is important to prevent further losses of life and property.

Amid many glacier hazards typical for the region such as GLOFs, glacier outbursts, surges, debris flows, the Huascaran disasters in 1962 and 1970 occupy a special place. We define them as catastrophic glacier multi-phase mass movements (CGMM). These are rare but devastating phenomena with transformation of initial failure to a debris flow due to progressive fluidization. Using high resolution false-colour infrared aerial imagery of 14 July 1970 we have mapped features of 31 May 1970 Huascaran disaster and compared these with features of the most recent CGMM – Kolka-Karmadon catastrophic event on 20 September 2002 in Russia. In comparison to previous studies, we have attempted to refine mapping of the boundary of Huascaran disaster zone in some areas, especially in the upper most part. Due to terrain features travel path of the Huascaran event was up to 3 times wider than of the Kolka-Karmadon event, despite the volume of Huascaran event being two times smaller. Both events were characterized by the same mass movement features except the stone hail which was observed only in the Huascaran zone, most likely due to the flow jump-off on a moraine ridge. Role of ice and snow was extremely important in both cases for mass fluidization, extraordinary velocity and long runout generation, but ice/rock proportion was different. Both events are repeated phenomena. Ancient deposits of previous events were found in devastated areas. Such phenomena call for special scientific attention and a specific research approach, because CGMM may affect areas remote from glaciers which were previously considered as safe.

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