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The increasing hazard of recent glacier-dammed lakes and outburst floods in the Hunza basin, Karakorum

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Glacial-dammed lakes play a prominent role in the natural landscape shaping processes of the Karakoram. In the upper Shimshal and Shishper valleys, the surging glaciers continually pose a threat to the downstream settlements due to formation and failure of ice dams. About 22 glacial floods have been identified and attributed to these glaciers in the central Karakorum from the last century including the outburst of 2017 in the Shimshal valley. The current of the Shishper lake is also expected to present devastating consequences. The erosion potential is obviously noticeable from the high loss of settlement areas in the Shimshal, Pasu villages and KKH (Karakorum high way). Previously, the lake formations were mainly attributed to the surging activities of these glaciers. Surge movements were recently recorded on November 2016 in Khurdopin glacier and 22 November 2018 in Shishper glacier, which caused the creation of new glacial dams which consequently evolved into GLOF hazards on 21 July 2017. This outburst event resulted to the damage of buildings and hanging bridges, and eroded agricultural lands the Shimshal valley. In this paper, we present a methodological approach for the glacier dynamics and GLOF draining processes via Pipe flow calculations of the subglacial tunnel drainage and downstream impact evaluation. The methodology was applied to the Hunza river basin. The Khordopin glacier has been shown to advance at an average surge of around 18 m per day from April 2017 to May 2017 which reduced to 10 m/day from May to June 2017 as computed from the satellite imagery obtained by Landsat 8 and Sentinel 2. The surge was observed to have advanced to a total distance of 18 kilometers from the terminus of the glacier. Different locations on the glacier, exhibited distinctive surge behaviors. The movement of the Shishper glacier is still being observed up to the present moment. Calculations of the increasing lake level (Shishper lake) and draining processes through subglacial tunnel and 1D hydraulic models of the river flood give consistent results and further verify the simulation findings. Through a field survey conducted to assess the potential damage caused by GLOF, it was found that a peak outburst flood could be in the order of 1672.34 m3/s. The analysis demonstrates that a large area of agriculture land, livestock, bridges and a huge amount of infrastructure are exposed to the GLOF. It is concluded that regular monitoring and the establishment of early warning systems are necessary for the prediction of glacial surging activities and glacial lake formations in the Shimshal and Shishper valleys.