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An approach for estimating the breach probabilities of glacial lakes in the Chinese Himalayas using remote-sensing data

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Abstract: To make first-order estimates of the probability of glacial lake outburst floods (GLOFs) and prioritize the risk posed by potentially dangerous glacial lakes (PDGLs) in the Chinese Himalayas, a more objective approach is presented. We first select five indicators to identify PDGLs according to four predesigned criteria. The climatic background was regarded as the loading of the moraine-dam failure, and under different climatic loadings, we distinguish the trigger mechanisms of GLOFs and subdivide them into 17 possible breach modes, with each mode having three or four components; we combined the loading, modes and components to construct a decision-making tree of moraine-dam failure. Conversion guidelines were established so as to quantify the probabilities of components of a breach mode employing the historic performance method combined with expert knowledge and experience. The region of the Chinese Himalayas was chosen as a study area where there have been frequent GLOFs in recent decades. The results show that the breaching probabilities (p) of 142 PDGLs range from 0.037 to 0.345, and they can be further categorized as 43 lakes with very high breach probabilities ($p \geq 0.24$), 47 lakes with high breach probabilities ($0.18 \leq p < 0.24$), 24 lakes with mid-level breach probabilities ($0.12 \leq p < 0.18$), 24 lakes with low breach probabilities ($0.06 \leq p < 0.12$), and four lakes with very low breach probabilities ($p < 0.06$).

Key Words: Moraine-dammed lake; Chinese Himalayas; Identification of dangerous glacier lake; Breach probability