Risk management and response process of moraine lakes GLOF in southwestern Tibet (China)

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The southwestern part of Tibet in China is one of the hardest-hit areas where Glacier Lake Outburst Flood (GLOF) occurs frequently in the Moraine Lakes of Himalayas. In the face of the increasingly severe GLOF threat of Moraine Lakes, it is urgent to build a risk management and response process of moraine lakes GLOF in this region. Therefore, we propose a multi-module, process-oriented approach to GLOF risk response (Monitoring-Evaluation-Simulation), which integrates remote sensing, field surveys, Geographic Information Science (GIS), mathematical evaluation models, and hydrodynamic models to carry out the monitoring and analysis of GLOF, susceptibility evaluation, and numerical simulation work in Moraine Lakes. In the monitoring section (remote sensing and field surveys), we find that typical Moraine Lakes in southwestern Tibet continue to expand in area and are prone to GLOF, which is mainly due to significant area expansion, large-scale ice/avalanches and landslides, and overflow or seepage at the terminal moraine dam. In the assessment part, based on the susceptibility evaluation factor of the glacial lake obtained by monitoring. We creatively use the grey correlation model to filter the GLOF susceptibility evaluation factors, so that the constructed GLOF susceptibility evaluation model has achieved good results (the model evaluation accuracy rate reached 84%, and the AUC value reached 0.874). In the modeling part, the GLOF modeling was carried out for the glacial lakes with high GLOF susceptibility determined by the assessment. It is also the first time that the FLO-2D model is used to construct the GLOF process of a typical Moraine Lake in the Himalayas. The simulation results show the effective simulation capability of the FLO-2D model (the simulated flow depth and flow velocity errors are both within 10%). In short, realizing the organic combination of monitoring, evaluation and simulation are one of the main advantages of the "Monitoring-Evaluation-Simulation" method. This approach effectively supports the prevention and control of GLOF in Moraine Lakes in southwestern Tibet and provides a new application idea for the risk management and response of GLOF in regional Moraine Lakes.