EGU2020-9725
https://doi.org/10.5194/egusphere-egu2020-9725
EGU General Assembly 2020

Early warning and risk perception of landslide hazard chain in the Wu Gorge, Yangtze River, China

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More than 2500 landslides in the Three Gorge Reservoir (TGR) region are affected by reservoir impoundment and seasonal water fluctuation since 2003, accounting for huge property loss and remaining a great threat to the local residents. In order to detect these landslides with potential threat, a series of early warning systems (EWS) at different scales of analysis were installed in this area, and have gained significant consequences in issuing alarm information. However, some catastrophic landslide, e.g., Hongyangzi landslide and Gongjiafang landslide, indicating that landslides in the TGR area should be considered as disaster chains, as the landslide-induced waves may have more serious influences. Therefore, it is necessary to carry out a prospective risk perception about landslide-induced wave based on the existing early warning. This paper aims to assess the risk of impulsive wave in the TGR with a quantitative method, and a new perspective about risk mitigation is proposed with the purpose of controlling the size of the surge. The risk assessment method mentioned is applied to Ganjingzi landslide, a typical colluvial landslide in the Wu Gorge, activating by reservoir impoundment and fluctuation. The EWS installed indicates that the landslide undergoes a retrogressive evolution, and local failure of the strong-deformation area will decrease the stability of the landslide and induce the movement. By preforming Tsunami Squares method, potential waves generate by Ganjingzi landslide with different failure situations are simulated. The quantitative risk analysis is carried out with the consideration of both sailing and moored vessels in the Yangtze River. The result reveals that impulse wave induced by the strong-deformation area causes the maximum economic loss, of about 0.59 million USD. Moreover, a new risk mitigation measure is designed to lower the speed of landslide intrusion into the reservoir. Compared with the traditional control measure that only use anti-sliding piles (about 21.4 million USD), reducing the load around the trailing edge of landslide and settling anti-sliding piles in the strong-deformation area (about 3.5 million USD) is more economical and effective. Overall, the proposed method for risk assessment and mitigation may provide a basis for the risk management of geological hazards and early warning in the other reservoir areas with similar geological conditions and environmental backgrounds.

How to cite: Liang, X., Yin, K., Chen, L., Du, J., Xiao, T., and Zhang, Y.: Early warning and risk

perception of landslide hazard chain in the Wu Gorge, Yangtze River, China, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-9725, https://doi.org/10.5194/egusphere-egu2020-9725, 2020