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Landslide Early Warning Systems Considering Impulse Waves – a Case Study of the Jiuxianping Landslide in the Three Gorges Reservoir Area, China

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Landslides along river, lake, reservoir and ocean shorelines may trigger impulse waves when they slide into the water body with a high velocity. This secondary process can extremely expand the area threatened by the landslide beyond its primary impact zone. Since the impoundment of the Three Gorges Reservoir in 2003, several landslides have caused huge property damage and several casualties due to an insufficient understanding of and reaction to impulse waves as a secondary process in landslide disaster risk management. This contribution aims to provide an integrative approach for risk perception and mitigation of a local landslide considering impulse waves as a secondary disaster risk.

Jiuxianping landslide is located in the middle part of the Three Gorges Reservoir in China. Featuring a large thick layer of rock slope, the elevation of the landslide ranges from 95 to 385 m a.s.l., and the volume is approximately $5.7 \times 10^7 \text{ m}^3$. The trailing edge of the landslide appeared as a more than 100 meters transverse tensile crack with an opening width of at least 25 cm in 2008, leading to damaged housing. The landslide stability is strongly influenced by rainfall and the reservoir water level. More than 300 people still live at the landslide site and there is a shipyard in operation at its toe.

As a new perspective to detect secondary disasters, the areas with the highest risk and probability of damage under different conditions were estimated using an auto search function in GeoStudio and the Morgenstern-Price method. Then, we simulated the landslide runout as well as wave generation and propagation using Tsunami Squares to predict the risk intensity and impact area of the generated impulse waves. Lastly, we evaluated the warning levels for different scenarios and proposed the area restricted for navigation at corresponding warning levels. Our case study demonstrates the necessity and the importance of considering secondary disaster risks such as impulse waves in landslide early warning system.

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