

## **Effect and mechanism of freeze-thaw process on surface erosion**

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Global warming and intensified climate variability have greatly affected Earth's surface processes and continental sediment evacuation. River suspended sediment is a sensitive indicator for tracing seasonal surface erosion, but details of the rates of sediment generation and evacuation, and their connections with nowadays warming climate are not entirely clear, particularly in Tibet and other high-altitude areas where field observations remain scarce. Here, we investigate daily to seasonal river sediment transport dynamics between the cold, permafrost-dominated northeastern Tibetan Plateau and warm, non-permafrost Sichuan and Taiwan regions. Our results show that at a given river water discharge, greater river suspended sediment was evacuated during the pre-monsoon season (April–Mid June) relative to other seasons in the cold NE Tibetan catchments. In contrast, no such phenomenon was observed in the warm, non-permafrost regions. These comparisons likely indicate a center role of freeze–thaw processes on loose sediment generation, which enhanced sediment output. Hydrometeorological records show up to  $\sim 2$  °C warming in the NE Tibetan Plateau since the past 30 years, coupled with an 8-fold increase in sediment transport. We suggest that continuous warming climate may further accelerate sediment and soil carbon release in the Tibetan Plateau and other global permafrost-dominated areas, which in turn influences climate feedback.