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Integration of fluvial erosion factors for predicting landslides along meandering rivers

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River incision and lateral erosion are important geomorphologic processes in mountainous areas of Taiwan. During a typhoon or storm event, the increase of water discharge, flow velocity, and sediment discharge enhances the power of river erosion on channel bank. After the materials on toe of hillslope were removed by river erosion, landslides were triggered at outer meander bends. Although it has been long expected that river erosion can trigger landslide, studies quantifying the effects of river erosion on landslide and the application of river erosion index in landslide prediction are still overlooked. In this study, we investigated the effect of river erosion on landslide in a particular meanders landscape of the Jhoukou River, southern Taiwan. We developed a semi-automatic model to separate meandering lines into several reach segments based on the inflection points and to calculate river erosion indexes, e.g. sinuosity of meander, stream power, and stream order, for each reach segment. This model, then, built the spatial relationship between the reaches and its corresponding hillslopes, of which the toe was eroded by the reach. Based on the spatial relationship, we quantified the correlations between these indexes and landslides triggered by Typhoon Morakot in 2009 to examine the effects of river erosion on landslide. The correlated indexes were then used as landslide predictors in logistic regression model. Results of the study showed that there is no significant correlation between landslide density and meander sinuosity. This may be a result of wider channel dispersing the erosion at a meandering reach. On the other hand, landslide density at concave bank is significantly higher than that at convex bank in the downstream (stream order > 3), but that is almost the same in the upstream (stream order < 3). This may imply that river sediment play different roles between down- and upstream segments. River sediment in the upstream is an erosion agent vertically scouring the river bed, resulting in a symmetrical effect on both concave and convex bank. In contrast, river sediment in the downstream is an erosion agent eroding the concave bank laterally, but also depositing on the concave side and protecting the bank from erosion. Finally, the results also showed that the integration of fluvial erosion factors can improve the performance in predicting landsliding along meandering rivers.