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Modelling the landslide area and sediment discharge in landslide-dominated region, Taiwan

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Many studies have indicated the magnified increase of rainfall intensification, landsliding and subsequent sediment discharge due to the global warming effect. However, a few works synthesized the “chain reaction” from rainfall, landsliding to sediment discharge at the same time because of the limited observations of landslide area and sediment discharge during episodes. Besides, the sediment transport strongly depends on the sediment supply and stream power which interact conditionally. In this study, our goal is to build a model that can simulate time-series landslide area and subsequent sediment discharge. The synthesized model would be applied onto Tsengwen Reservoir watershed in southern Taiwan, where lots of landslides occur every year. Unlike other studies, our landslide model considers not only rainfall effect but also previous landslide status, which may be applied to landslide-dominated regions and explains the irrelevant relationship between typhoon rainfall and landslide area. Furthermore, our sediment transport model considers the sediment budget which couples transport- and supply-limited of sediment. The result shows that the simulated time-series landslide area and the sediment transport agree with the observation and the R2 are 0.88 and 0.56, respectively. Reactivated ratio of previous landslide area is 72.7% which indicates the high reoccurrence of historical landslide in landslide-dominated regions. We divided nine historical typhoons into three periods to demonstrate the effect of sediment supply/supply-limited condition upon sediment transport. For instance, the rainfall is smaller in period 3 than in period 1 but the sediment transport is higher in period 3 due to the catastrophic landslide (typhoon Morakot) during period 2. We argue that quantifying sediment transport should couple not only with water discharge but sediment budget, which is rarely considered in calculating sediment transport. Moreover, the parameterization of the controlling factors can quantify the impact of available sediment on sediment discharge and further for relevant assessment for climate change.