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Comparison of different representations of physical erosion on modeling chemical weathering in landslide-dominated region

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Chemical weathering, characterized by CO_2 consumption, attracts much attention, particularly in landslide-dominated regions where the physical erosion rate (PER) may enhance the chemical weathering rate (CWR) which influences the stability of hillslope and nutrient supply of ecosystem. Recently, a great debate is on the coupling or decoupling with CWR and PER in high erosion area, particularly in the landslide-dominated region. However, the representations of PER either by sediment yield (West et al., 2005) or estimated by landslide distribution (Gabet, 2007) in such regions is rarely evaluated and discussed. Hence, we combined these two models on 29 catchments in Taiwan, famous for rapid erosion and weathering, to clarify how representations of PER affected estimation of chemical weathering in landslide-dominated regions. The results showed that in the sediment yield-based model, the coupling between CWR and PER in terms of power function (α, from CWR=PER$^{\alpha}$) were 0.09, 0.26, 0.22 for silicate weathering (CWR_{sil}), carbonate weathering (CWR_{carb}), total chemical weathering (CWR_{tot}), respectively. The R^2 values were 0.48, 0.49, 0.57 for CWR_{sil}, CWR_{carb} and CWR_{tot}, respectively. Meanwhile, in the landslide-based model, α of CWR_{sil}, CWR_{carb} and CWR_{tot} were 0.78, 0.79, 0.79, respectively. The R^2 values were 0.41, 0.58, 0.67, respectively. In sum, both model could perform the linkage between CWR and PER satisfactorily. The sediment yield-based model revealed CWR might be strongly kinetically limited. Besides, despite of lower performance than the landslide-based model, it distinguished relationships between different CWR(CWR_{sil}, CWR_{carb}, CWR_{tot}) and PER, but simulations of the landslide-based model were reversed. The α of the landslide-based model is significantly higher than previous studies. It implies that on perspective of landslides, PER may enhance CWR and matches with current researches.