



Landscape evolution of the northern Hsuehshan Range in Taiwan inferred from fluvial channel morphology

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The evolution of topography is fundamentally coupled with changes in river channel networks. Erosion rate of a river system into a landscape depends on many factors, including climate, base level, tectonics and lithology. Most previous studies assumed that river networks and watershed boundaries are stable through time. However, if rivers on both sides of the drainage divide have different erosion rates, the divide may move due to the erosion rate difference. In this study, we used a new method of the fluvial geomorphic index χ to analyze the river networks in the northern Hsuehshan Range of Taiwan. The parameter χ provides a prediction of steady-state elevation for a given point along a channel. By comparing the χ values of river tributaries on both sides of the drainage divide, we can obtain the information of the divide condition. If χ values are similar on both sides of the divide, the boundary is generally stable. By contrast, if χ values are very different on the two sides, the boundary is unstable, and the river systems will migrate toward the high χ side until they achieve a stable configuration. We found that on the same side of the northern Hsuehshan Range main divide, the river basins are generally stable, but the main water divide of the Hsuehshan Range is unstable. Based on the results of χ values, river steepness index (ksn), satellite image analysis, and field investigations, the main drainage divide may move from southeast to northwest at a rate of about 10 mm/yr. This movement is likely produced by the general tectonic setting of the area and the activity of the Northern Ilan structure. From our results, we also propose a mechanism for how rivers interact with each other on both sides of the water divide. We hope this study would provide more information for reconstructing river basins in the past and understanding their developments in the future.