Geomorphic mapping using pixel-based slope-area plots

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Slope-area plots have been frequently applied to extract geomorphic process domains from digital elevation models (DEMs). The transition between process domains is generally related to the inflection of the scaling between averaged slope gradient and area, which is diagnostic to the dominant process mechanisms for certain contributing areas. Hillslopes are dominated by divergent flows and show positive scaling between slope and contributing area. In contrast, debris flow dominated channels, bedrock channels and alluvial channels are characterized by convergent flow and thus negative scaling exponents of different degree. Averaged slope gradients, which are calculated using logarithmic bins of contributing area, generally do not consider the scatter observed in pixel based slope area plots. However, we state that the residuals from a deterministic slope-area model spanning the entire upslope area range provide useful information to extract geomorphic process domains beyond the simple stratification using contributing area.

In this paper, we present a methodological approach and first results of an explorative analysis that combines pixel based slope area plots and geomorphic maps in order to derive a process based automated mapping procedure. We use geomorphic maps to identify dominant process domains in slope-area plots and analyze the emergent pattern in different geomorphic environments (e.g. alpine, arid, cuesta landscapes and wash dominated hills) and regions (e.g. Swiss Alps, Israel, SW-Germany, Canadian Rocky Mountains, and Japanese Alps).