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Sensitivity of slope-area plots: consideration of DEM-effects in different geomorphic environments

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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 slope and area. While hillslopes are dominated by divergent flows and therefore show positive scaling between slope and contributing area, debris flow dominated channels, bedrock channels and alluvial channels are characterized by convergent flow and thus negative scaling exponents of different degree. The transitions between these process domains are assumed to depend on site-specific climate, uplift, rock strength and geomorphic history.

The extraction of slope and contributing area from DEMs, however, is strongly dependent on the accuracy and resolution and thus on the source of the DEMs. Lately, the development of airborne laser technologies provides high-resolution DEMs (e.g. light detection and ranging LIDAR DEMs), which permit a more detailed representation of the Earth surface and thus provide great potential for the differentiation of geomorphic process domains. Despite these recent developments a systematic comparison of the advantages and disadvantages of high resolution DEMs concerning the scaling of slope and area is still missing.

Here, we present an extensive analysis of slope-area plots from 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) extracted from DEMs obtained from a large range of sources and thus accuracy and resolution. We will critically discuss different methods and DEM-sources for the generation of slope area plots and thus the explanatory power of slope area plots.