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An efficient and parameter-free algorithm to delineate slope units for landslide susceptibility

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Slope units are terrain partitions bounded by drainage and divide lines, which have been shown to overcome many of the weaknesses of the traditional grid mapping units in landslide susceptibility models. Namely, they better capture the geometry of the terrain, mitigate the need to use multiple raster resolutions when the size and shape of landslides in the region are highly variable, provide a solution for incorporating landslide data in different formats (i.e., point and vector), and are more amenable to landslide repositories with less accurate landslide locations. However, the use of slope units in landslide susceptibility studies remains limited due, in part, to challenges with current delineation methods, including prohibitive computational costs, time-intensive manual processing, or indeterminate parameterizations. We introduce a computationally efficient algorithm for the parameter-free delineation of slope units. Our method determines the scaling of the watersheds at the threshold between fluvial and hillslope processes. It then subdivides these watersheds according to their longest flow paths. Our algorithm can run in parallel, effectively delineate slope units orders of magnitude faster than other parameter-free methods, and requires no significant pre- or post-processing to use. Here we explore the implementation of our algorithm and demonstrate some of the advantages of slope units over the grid-cell mapping unit for evaluating landslide susceptibility.