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How well can we approximate the failure surface and estimate the amount of landslide mass? An idealized failure surface for predicting its traveling path

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With the hillshade imagery from LiDAR-derived DEM one might be able to identify the outline of a slide mass that reflects aspects of movement. There are also several empirical relations linking the landslide area to the corresponding volume. However, a definite failure surface is needed for performing numerical simulation in the framework of hazard assessment. In the present study we proposed an idealized surface to approximate the failure surface of landslide of slide type for predicting the consequential mass moving path as well as the traveling distance. This idealized failure surface is geometrical, where neither morphological influence nor mechanical property of the failed soil or rocks is taken into account. It consists of a down-slope curvature and cross-slope curvature, and the area should match the one defined by the LiDAR dataset. The volume of landslide material can be determined either by the empirical relationships or by the slice method of stability analysis. This idealized failure surface has been applied and validated against 16 landslides, within three different water catchments in Taiwan. A specific relationship between the curvature and depth (with respect to the lengths of the down-slope line and cross-slope line) is suggested. Hence, it becomes possible to determine the idealized sliding surface by a defined susceptible area and its corresponding volume. For the sake of hazard assessment, the proposed method has been integrated with a numerical model for back-calculation against history landslides, where the moving mass is treated as a two-phase grain-fluid mixture. Although the idealized failure surface may deviate from the post-event measurement, the numerical results reveal that no significant discrepancy is identified for the flow paths or deposition locations. That is, the landslide volume is much dominant for the traveling path.