Extraction and evaluation of dissection fronts on hillslopes using airborne laser scanner data

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Landslides and debris flows occur when rainstorms destabilize hillslopes in the upstream area. Such topographic changes often take place near the so-called dissection front at the boundary between a stabile region (low-relief surface) and unstable steep slopes. Existing methods for mapping dissection fronts rely on visual interpretation of aerial photographs and ground truthing, which is tedious for investigating a wide area particularly when the ground is forested. In this study, we developed a method for automatically extracting dissection fronts using a high-resolution DEM (digital elevation model) derived from airborne laser scanner data. The airborne laser scanner can be used to record minute geomorphological features in a wide area and it scans ground surfaces through the interstices of tree canopies.

We analyzed landforms in Okaya City in central Japan where landslides and debris flows were induced by a rainstorm in July, 2006. We developed a method of automatic extraction of convex slope break points using morphometric parameters derived from airborne laser scanner data such as slope, Laplacian and the standard deviation of slope. The extracted points often correspond to dissection fronts inferred from visual interpretation of landforms. Although they also occur near the landslides, their location tends to be closer to the valley line and farer from the ridge line than the landslide location. This observation indicates that depressions along the convex slope breaks favored landsliding due to water concentration, and such erosion enhanced further retreat of the breaks. Therefore, distances from the ridge and valley lines may provide a guideline for evaluating geomorphic processes along dissection fronts on hillslopes.