Comparison between automated and interpreted landform classification maps in Tomari-no-tai area, Shirakami Mountains, Japan

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This study compared the automated landform classification map with the interpreted map in Tomari-no-tai area (3.8 km^2) in Shirakami Mountains in northwest Japan, where heavy snow is annually recorded. The former map thematically explains morphology and the latter map explains landform evolution, namely, the characteristics of both landform classification maps are different. To produce the maps, in advance, airborne light detection and ranging (LIDAR) data were measured 1,200 m above the ground on 30 October 2004, the data have the density of a few laser light reflected points per 1 m^2. The points reflected on the ground were selected, and two-meter-grid digital elevation model (DEM) and one-meter-interval contour map were produce.

The former map (Fig.(a)), based on the DEM, was produced by the combination of three-classified slope, two-classified surface texture (coarse and fine) divided by the average value, two-classified local convexity (concave and convex) divided by the average value, namely, 12 classification map (Iwahashi and Pike, 2007). Slope was calculated from the DEM, and it was found that frequency's peak 31 degree corresponds to the slope average value and 0-15 degree, 15-31 degree, and more than 31 degree was assigned to gentle, medium, and steep, respectively. Surface texture is the index to express the surface's coarse or fine, and it was calculated from the total grid-cell number of pit and peak in searching circle (radius, 10 grid-cells) divided by the circle area (namely, 314 grid cells). The pit and peak mean the grid cells where the original grid-DEM is less and more than an obtained grid-DEM derived by passing the original through the three by three median filter in area, respectively. Local convexity was calculated from the total grid-cell number of convex-upward in searching circle (radius, 10 grid-cells) divided by the circle area (namely, 314 grid cells). The convex-upward grid cells were measured by the three-by-three Laplacian filter, yielding positive values when the grid cell is convex-upward. If negative, it falls on concave cells, zero, planar cells. Legend of the automated map is as follows; A1. gentle-coarse-concave, A2. gentle-coarse-convex, A3. gentle-fine-concave, A4. gentle-fine-convex, A5. medium-coarse-concave, A6. medium-coarse-convex, A7. medium-fine-concave, A8. medium-fine-convex, A9. steep-coarse-concave, A10. steep-coarse-convex, A11. steep-fine-concave, A12. steep-fine-convex.

The latter map, which has 19 classifications (refer to session J171, [Landform classification mapping in Tomari-no-tai area, Shirakami Mountains, Japan]), were produced by combining interpretation results on the one-meter-interval contour map and 1/8,000-scale aerial photographs. The legend is as follows: B1. Crest slope, B2. Upper slope, B3. Landslide side slope, B4. Lower slope, B5. Avalanche furrows; B6, B7, B8. Steep (22-25 degree), Medium (9-14 degree), Gentle (5-8 degree) slope alluvial fan, respectively; B9. High-level surface, B10. High-level gentle slope, B11. Low-level surface, B12. Slope failure (clear), B13 Slope failure (semi-clear), B14. Slope incised by avalanche furrows, B15. Scarp, B16. Landslide, B17. Enchelon cliff, B18, Debris-flow terrace, B19. Valley bottom.

As a result of overlaying between two maps (Fig. (b)), it was found that B2 shares more than 50% in area ratio in A6 and A10, respectively; B16 occupies more than 17% in area ratio in A3, A4, A7, A8, respectively; B15 was expected to be existed in A9-A12, however, at most 11.5% and 8.4% in A6 and A5, respectively.

Reference

Iwahashi J, Pike RJ (2007) Automated classifications of topography from DEMs by an unsupervised nested-means algorithm and a three-part geometric signature. Geomorphology (in press)