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The role of mass rock creep on surface shape revealed by LiDAR.

Osamu Yokoyama[1*], Taro Uchida[1], youko nakano[1], ISHIZUKA Tadanori[1], KASAI Mio[2], Ryuji Suzuki[3]

[1]Public Works Research Institutes, [2]Hokkaido University, [3]Disaster Prevention and Mitigation Eng

Deep catastrophic landslide which bedrock failed might cause large-scale landslide dams and debris flows, and might afford the great deal of harm to around areas. In the study, term of deep catastrophic landslide means rapid landslides and excludes slow failures of a more chronic nature, such as deep-seated gravitational creep or rock flow. The prediction of location of deep catastrophic landslide is important to reduce such sediment disasters. Long-lasting, small-scale mass movements called gravitational mass rock creeps sometimes lead to deep catastrophic sliding. Therefore, it can be though that the spatial distribution of landforms related to long-lasting mass movements, such as rock creep slopes, downhill-facing scarps and so on, may provide an index for deep catastrophic landslide susceptibility.. To clarify spatial distribution of mass rock creep, interpretation of aerial photographs was often used. However, the interpretation of aerial photographs was affected by vegetation and the removals of vegetation effects were very difficult. Also this method needs a lot of skills. On the other hand, the LiDAR develops rapidly in recent years, and can understand detailed surface shapes in the mountainous district where the forest grows thickly. In this study, we used LiDAR data .to clarify the surface geometry of the mass rock creep slope and non-mass rock creep slope quantitatively,

The study area is Mt. Wanitsuka in the southern part of Kyushu. In this area, many deep catastrophic landslide occurred by heavy rain in September 2005, seven of which occurred at the slopes where could be found signatures of mass rock creep before occurrence of deep catastrophic landslide. We conducted detailed geological survey and interpretation of aerial photographs clarify spatial distribution of mass rock creep. We derived 2-m grid DEMs used the LiDAR data, and calculated the slope gradient and the eigenvalue ratio. The eigenvalue ratio is an index that expresses a degree the ruggedness on the surface. When the eigenvalue ratio is large, the slope surface is smoothly. In contrast, when the eigenvalue ratio becomes small, the slope surface is large ruggedness and undulate. Moreover, we calculated the slope gradient and the eigenvalue ratio using six additional grid cell sizes (4m, 10m, 20m, 30m, 50m, and 100m).

Slope gradient of mass rock creep was gentle, compared with non-mass rock creep, regardless of gird size. On the other hand, there was a difference in the distribution of the frequencies between mass rock creep slope and non-mass rock creep slope. When we used 2m as gird size for calculation, the difference in eigenvalue ratio between mass rock creep and non-mass rock creep was small. While we used 20-30m, these are large differences in eigenvalue ratio between mass rock creep and non-mass rock creep. However, we used 50-100 m as grid size, the difference became small. The change of the eigenvalue ratio distribution by the grid size indicates the different geometry between the valley and the ridge at the mass rock creep slope and non-mass rock creep slope. That is, the mass rock creep has shallow and rounded valley, and the non-mass rock creep has deep and steep valley. Thus, it can be thought that the mass rock creep slope can be extracted in quantitatively by using the LiDAR data.

Keywords: mass rock creep, deep catastrophic landslide, LiDAR data, eigenvalue ratio